



THE FEDERAL GRAZING FEE: 1993

GRAZING FEE TASK GROUP

E. Tom Bartlett, Colorado State University, Leader
Neil Rimbey, University of Idaho
L. Allen Torell, New Mexico State University
Larry W. Van Tassell, University of Wyoming

John DeVilbiss, USFS Region 2
Don Waite, BLM Washington DC, Advisor

Ron Appel, BLM Montana, Appraiser
Tim Heisler, BLM New Mexico, Appraiser
Gerald Stoebig, BLM Nevada, Appraiser

Tom Bagwell, New Mexico State University, Research Associate
Paul Burgener, University of Wyoming, Research Associate
Juli Coen, University of Idaho, Research Associate

May 21, 1993

EXECUTIVE SUMMARY

A task force was formed in May of 1992 to recommend an incentive based grazing fee for lands administered by the Bureau of Land Management (BLM) and U.S. Forest Service (USFS). The task was divided into two topics: 1) incentives for enhanced rangeland stewardship, and 2) evaluation of the grazing fee issue. The second task was assigned to the Grazing Fee Task Group (GFTG) with the following objectives:

1. Determine the basis for establishing current forage values,
2. Determine the basis for establishing grazing fees,
3. Determine appropriate pricing areas, and
4. Determine an appropriate procedure for updating grazing fees.

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The GFTG determined that competitive market prices for private range lands, where existing conditions market prices, would provide the best estimate of the value for public land forage. A total cost comparison of the for and non-for costs of grazing private and public lands was made. These costs included expenses for housing and moving livestock, travel to and from allotments, supplemental feeding, lost interests, maintenance and depreciation of range improvements, and others. The total cost approach considers the difference between total grazing costs on public and private lands and establishes public land forage value at this difference.

Other market price sources were also considered, including a market appraisal, a detailed analysis of private lands and the use of grazing permit values to give a direct measure of the value of public land forage. Alternative methods for indexing market values through cost were also explored.

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The GFTG determined that a comparison to the private forage market, where competition establishes market price, would provide the best estimate of the value for public land forage. A total cost comparison of the fee and non-fee costs of grazing private and public lands was made. These costs included expenses for herding and moving livestock, travel to and from allotments, supplemental feeding, lost animals, maintenance and depreciation of range improvements, and others. The total cost approach considers the difference between total grazing costs on public and private lands and establishes public land forage value as this difference.

Other market price comparisons were also considered, including a market appraisal, a statistical analysis of private leases and the use of grazing permit values to give a direct estimate of the value of public land forage. Alternative methods for indexing market values through time were also explored.

Grazing fee studies were conducted in New Mexico, Wyoming and Idaho. Total grazing costs were gathered through personal interviews from 258 ranchers using 245 public grazing permits and 149 private leases. A limited sample of 43 leases of public forage in New Mexico and Wyoming were used as a market appraisal comparison. Ranch sales data used to determine permit value included public land ranches with over 775 grazing permits in the three states.

The Grazing Fee Dilemma

The government is not collecting the full market value for grazing public lands, but ranchers are paying full value through the current fee, non-fee grazing costs, and the grazing permit. Past grazing fee policy has contributed to the value of grazing permits and current ranchers have paid this cost. Some of the value for public land grazing has been capitalized into the value of public land ranches and is bought and sold in the ranch real estate market. Legal precedent says permit value need not be considered in setting grazing fee policy, but the allocation of permit value remains a central issue of the grazing fee debate.

There is a strong theoretical linkage between grazing fees and permit value. As fees go up, permit values should erode and wealth will be transferred from ranchers to the land agencies. Past policies have allocated permit value to ranchers and higher grazing fees will reallocate this value to land agencies. This is the dilemma that policy makers face. The GFTG does not imply that this transfer is right or wrong, but the concern about the fairness of reallocating income is obvious.

Major Findings

Results from this study support the following conclusions.

Total Cost Approach

We were surprised to find that the total cost valuation yielded inconsistent results. This cost analysis demonstrated that many public land ranchers have been willing to pay more in total costs for grazing than the apparent value implied from the private forage market. Consequently, we discount this method as a way to estimate the willingness of public land ranchers to pay for grazing on public lands.

With the 1992 grazing fee of \$1.92/AUM, 34 percent of cattle producers on BLM land, 62 percent of USFS cattle producers, 60 percent of BLM sheep producers and 92 percent of USFS sheep producers paid more for grazing public lands than did those grazing privately leased lands. In most cases, the belief that public land ranchers pay less than those leasing private lands is not justified, especially when permit investments are considered.

Total grazing costs were found to be higher on USFS and for sheep leases when compared to private leases, implying a negative forage value. The lack of comparable private land leases to use in establishing forage value for USFS and sheep allotments precludes a market price comparison in these cases. We do not believe the negative forage values estimated for USFS and sheep allotments accurately represent what public land ranchers would be willing to pay for the forage. These ranchers have demonstrated their willingness to pay the current PRIA fee, while USFS and some sheep permits have maintained a positive market value. Forage values estimated using the total cost approach were in the range of \$3 to \$4/AUM for cattle grazing BLM land, and minus \$2.86/AUM for cattle on USFS land.

Indexing of the PRIA Base

The \$1.23/AUM base forage value in the current PRIA formula was determined from an extensive survey conducted in 1966 using the total cost approach. Values determined by indexing this base to current value ranged from \$2.73/AUM to \$3.34/AUM, depending on the indexing method used.

Permit Value Approach

Grazing permit values imply a forage value of \$3/AUM to \$5/AUM in the three test states. This value represents the amount public land ranchers have paid for the grazing privilege and is a direct estimate of the willingness to pay for grazing on public lands. The value estimate derived using this method depends largely on the interest rate used to amortize permit investments.

Market Appraisal Approach

The market rental appraisal approach estimated 1992 forage value to be \$3.40/AUM in New Mexico and \$7.19/AUM in Wyoming. An appraisal using this approach was not made in Idaho. The number of private leases that are comparable to public lands without major adjustments limits the potential to use this approach to value public land forage.

Market Statistical Approach

Statistically separating the value of forage from the value of lessor provided services resulted in a net forage value estimate on private leases of \$8.42/AUM in Idaho, \$4.79/AUM in New Mexico, and \$6.93 in Wyoming. These estimates represent non-serviced private leases not non-serviced public leases. It is not possible to do this type of analysis on public land permits because services are not provided by the federal land agencies.

Pricing Areas

Similar to the findings of the 1966 grazing cost survey, we found variability in costs and lease rates within specific areas to be as large as the variability between areas. The forage market is not a highly refined, price discriminating market. There is no economic basis to regionalize grazing fees.

Updating Grazing Fees

Including the "ability-to-pay" indices (Beef Cattle Price Index and Prices Paid Index) in the PRIA fee formula, has caused the calculated grazing fee to fall behind forage value through time. Had the \$1.23/AUM base fee been indexed by only the Forage Value Index (FVI), the grazing fee would have been \$3.26/AUM in 1992. This compares to the range of values determined by the various methods. Regression results showed that the FVI has been the most important factor in explaining annual variation in private lease rates. Adding the BCPI and PPI to the PRIA formula did not improve the tracking ability of the formula as anticipated by the Grazing Fee Technical Committee assigned to evaluate grazing fees in the 1960's. The FVI will adequately update the grazing fee on an annual basis and account for ranchers "ability-to-pay".

Recommendations

We concluded from the results of our studies that the value of public land forage in the three test states is not different and lies somewhere between \$3/AUM and \$5/AUM. This assessment relies heavily on the values implied from grazing permit values that give a direct estimate of ranchers willingness to pay. The following are our recommendations.

1. **THE GRAZING FEE SHOULD BE ADMINISTRATIVELY OR LEGISLATIVELY DETERMINED WITHIN THE RANGE OF \$3 TO \$5 PER AUM.**
2. **ANY BASE GRAZING VALUE SHOULD BE APPLIED WESTWIDE.**
3. **ANY BASE GRAZING VALUE SHOULD BE UPDATED ANNUALLY WITH THE FORAGE VALUE INDEX (FVI).**

$$\text{GRAZING FEE}_t = \text{BASE VALUE times FVI}_{t-1}$$

4. **THE BLM AND USFS SHOULD INVESTIGATE THE POTENTIAL OF IMPLEMENTING A COMPETITIVE BID SYSTEM THAT WOULD CREATE A MARKET FOR PUBLIC LAND GRAZING.**
5. **ADDITIONAL STUDIES TO DEFINE THE MARKET VALUE OF PUBLIC LAND GRAZING USING MARKET PRICE COMPARISONS ARE NOT JUSTIFIED.**

Preface

The Director of the Bureau of Land Management formed a task force to develop the concept of an incentive-based grazing fee system and to test its application to on-the-ground situations. The Incentive Grazing Fee Task Force was divided into two groups; one would study and test an incentive system and the other would evaluate methods of determining forage value and the grazing fee. The latter is the Grazing Fee Task Group (GFTG) which has developed this report.

The GFTG was charged with taking a fresh look at the grazing fee issue. The GFTG realized at the onset that no grazing fee system existed nor could one be devised that would satisfy all interested parties. The GFTG reviewed past grazing fee studies and prepared a background document that provided the basis for future work. We developed procedures to evaluate alternative methods of determining forage value and collected information on grazing costs in Idaho, New Mexico, and Wyoming. Forage values were estimated in this three-state test area and compared to previous work and value estimates determined using market appraisal techniques. We also tested various pricing area alternatives. Finally, we made recommendations on how forage values should be determined and updated.

The GFTG was composed of economists and appraisers from the Bureau of Land Management, Forest Service and academia. The two professions have had differing approaches to the grazing fee issue in the past. In this effort they complemented one another. The GFTG takes responsibility for the contents of this report; the views are of the authors and not the agencies or universities for whom the GFTG members work.

Acknowledgments

We wish to thank many people who either provided information or helped compile information for this report. First, we thank the 397 private and public land ranchers that took from 1½ to 4 hours of their time to provide detailed information about the costs and inputs used on their ranch operations. We also thank colleagues, graduate students and Extension Agents including Ron Hillman and Lee Sharp in Idaho; Larry Brence, Tracy Drummond, and Marc Kincaid in New Mexico; and Les Burrough, Ron Cunningham, Gerald Fink, Jim Gill, Scott Hininger, Jay Jenkins and Eric Peterson in Wyoming for their assistance in data collection and analysis. Other staff personnel including Theresa Araquistain, Sue Rimbey, and Mark Coen helped with data entry. Dr. Morris Southward of New Mexico State University gave valuable advise on statistical analyses. We also thank the peer review panel, Drs. Thomas Quigley, Gerhard Rostvold, Norman Whittlesey and John Workman, for their reviews and suggestions.

We thank Bureau of Land Management and U.S. Forest Service personnel in various District and regional offices that helped compile allotment statistics for rancher interviews. A major effort was necessary by agency personnel to search for federal subleases and provide data on federal allotments.

K. Lynn Bennett provided the leadership that was invaluable to the Grazing Fee Task Group as well as the Incentive Based Grazing Fee Task Force. Carol Hadley of the Nevada State Office of the Bureau of Land Management was always available to make arrangements for equipment and facilities. The persistence of Dave Goicechea in obtaining funding for the university personnel was appreciated. The Cooperative States Research Service of USDA is acknowledged for their assistance in funding.

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CHAPTER I

INTRODUCTION

Grazing fees on public lands have been an issue since before the Forest Service established grazing regulations in 1906. Studies on the economic value of grazing public forage have occupied economists for most of the twentieth century. Grazing fees continue to be a political issue in the 1990's with legislation introduced in Congress during the last several years.

A task force was formed in May of 1992 to recommend an incentive based grazing fee for lands administered by the Bureau of Land Management (BLM) and USDA Forest Service (USFS). The task was divided into two topics: 1) incentives for enhanced rangeland stewardship, and 2) evaluation of the grazing fee issue, although both are being considered simultaneously. The Grazing Fee Task Group's (GFTG) objectives and selection criteria for a grazing fee are presented followed by a discussion of potential methods for estimating the economic value of public land forage, selecting pricing areas, and testing the validity and comparability of forage value estimates derived using alternative valuation procedures. The results of the forage valuation study are presented followed by a discussion of forage valuation, grazing fees, pricing areas, indexing of forage values, and comparison to criteria established for a desirable grazing fee. Finally, the GFTG draws conclusions and makes recommendations about what method should be applied to determine a grazing fee, what pricing areas should be used, and how the fee should be updated through time.

Objectives

The GFTG was given two directives: 1) recommend a method for establishing grazing fees, which includes a procedure for updating the fees periodically, and 2) recommend pricing areas to use in establishing fees. The primary evaluation criterion for establishing grazing fees was that fees should be based on the economic value of the forage.

The major task undertaken was to evaluate alternative methods that could be used to establish forage value. Specific tasks included:

1. Determine the basis for establishing current forage values,
2. Determine the basis for establishing grazing fees,
3. Determine appropriate pricing areas, and
4. Determine an appropriate procedure for updating grazing fees.

The GFTG did not conduct extensive new studies, such as the data collection efforts of federal land agencies in the 1960's and early 1980's. Limited studies in selected areas were conducted for testing and evaluation of alternative fee systems and pricing areas.

Criteria

A desirable grazing fee can only be defined when the criteria against which evaluation occurs are clearly defined. The criteria used here were categorized under the general headings: 1) valuation of forage, 2) establishing grazing fees, 3) updating grazing fees, and 4) determining pricing areas. An additional category included other considerations which, although important to the establishment of grazing fees, were not criteria addressed by the GFTG. All criteria are listed below, by category. Several criteria may be applicable to more than a single category. In these cases, criteria were included in each category and described as they apply to each situation.

Valuation of Forage

1. Market Value: This criterion requires that forage values estimated by alternative methods be based on accepted methods and procedures. Valuation methods should consider differences in productivity and non-fee grazing costs. On public rangelands, as on private lands, not all land is of equal value or productivity. As such, a desirable valuation method should account for differences in productivity and quality, and explicitly adjust for differences in user costs and regional differences in value. Grazing cost differences are also important when defining pricing areas.

Debate continues as to whether the investment value of public land grazing permits should be considered in the establishment of forage value and when setting grazing fees. On one hand, it is argued that because the purchase price of the ranch base property included the permit value, the capitalized value of the permit should be considered a legitimate cost of doing business when setting grazing fees. On the other hand, the government has not given title for the grazing to the rancher, therefore, the rancher does not own a property right to the grazing resource. As a result, the rancher does not have a corresponding economic "right" to the permit value; the property right being retained by the government.

Given that a public land rancher holds a permit, or privilege, to graze on public lands and not a legal property right to the permit, the issue becomes whether or not the capitalized value of the grazing permit should be retained by the government. If the value of the permit, in fact, is retained by the government, then should its capitalized value be considered when determining grazing fees? Legal precedent following fee increases in the 1960's found that action taken by the Secretaries of Interior and Agriculture not to consider permit value as a cost item and to raise grazing fees on this ground was proper (*Pankey Land and Cattle Co. v. Hardin and Hickel*, Cite 427 F.2d 43 1970). The Supreme Court ruled that permits to use the public domain for grazing are revocable and create no property rights to the holder (*United States v. Fuller*, 409 U.S. 488 1973). Permit value continues to be a central issue in grazing fee debates.

Establishing Grazing Fees

2. Net Payments to State and County Government: State and county governments receive payments from the federal government based on a percentage of the receipts to the U.S. treasury provided by federal lands located in each state and county. They also receive payments based on a formula for payment in lieu of taxes (PILT's). Total payments take into consideration both payment sources (PILT's and grazing fee distribution funds from the agencies), and in some situations changes in payments from one source may be offset by payments from the other source. This criterion will consider the overall or net payment effects to state and county governments.

3. Program Cost Recovery: Although the costs of providing forage to the user is not a determinant of market value, it is a factor to be considered in the amount to be charged as a grazing fee. Given that covering the cost of permit operation and administration has evolved as an important issue with respect to the establishment of grazing fees on public rangelands, it will be included as a criterion. This criterion addresses the question, "Will grazing fees cover the cost to the public agency of providing forage to users?"

4. Administrative Feasibility: The method used to determine grazing fees and to adjust values through time must be understandable by the various agencies and, equally important, by the public (see criterion 7).

Updating Grazing Fees

5. Maintain market value over time: A grazing fee system should prevent future discrepancy between fees charged and market value. The fee system should include regular adjustments to account for changes in value.

6. Ability-to-pay: As the cost to the user varies because of inflation or other real cost changes reflective of both private and public land grazing, these cost changes should be incorporated into a revised estimate of value. To the extent these costs were incorporated into the initial forage valuation, changes in production costs should be considered in the adjustment of forage value over time. In similar fashion, changes in product prices should be considered in updating forage values over time.

Determination of Pricing Areas

7. Administrative Feasibility: Grazing fees must consider the cost to the government of implementing and updating the fee system. If the method for calculating forage values or establishing grazing fees requires a substantial amount of data, particularly from relatively small geographical areas, the cost of collecting and processing the data may be excessive. Data must be reasonably available for the grazing fee calculation method to be administratively feasible.

8. Productivity/Ecological Variations: When forage values are estimated on a relatively broad geographical basis, spatial differences are masked through the averaging of data. As a result, average market values will be excessive in some areas and insufficient in others. This will result in operators being overcharged, or undercharged, for grazing. This criterion will address the need to regionalize forage values and grazing fees.

Other Considerations

The following factors were also considered by the GFTG. They were incorporated into criteria shown above or were considered and deleted as criteria.

9. Shared Use: It has been argued that when livestock grazing is one of a number of multiple uses of public land, consideration should be given to the increased costs ranchers must incur to operate in the multiple use setting. To the extent costs are incurred by the rancher in using rangeland forage, they are considered in Criterion #1 above. Conversely, additional costs may be imposed on other users by grazing public lands. This consideration is not included as a separate criterion in this study.

10. Community and Industry Stability: The Public Rangeland Improvement Act (PRIA) of 1978 states "... to prevent economic disruption and harm to the western livestock industry, it is in the public interest to charge a fee for livestock grazing permits and leases on the public lands which is based on a formula reflecting annual changes in the costs of production." Adjustments for "reflecting annual changes in the costs of production" are included in the Indexing Criterion # 6, above. This consideration is not included as a separate criterion in this study.

11. Equity to livestock producers without federal permits: A grazing fee established for public lands that is based on market value will not provide an unfair advantage to producers utilizing public resources. This requirement is addressed through consideration of criteria #1, Market Value; #3, Program Cost Recovery; and #6, Ability-To-Pay listed above.

12. Benefits to other uses of public lands: It has been argued that in determining grazing fees, consideration should be given to benefits and costs that livestock producers and the grazing program have on other uses such as wildlife, water and recreation. In establishing the grazing fee on a market value basis, livestock producers are given full consideration for the benefits due them through their profit margins. In cases where producers are improving rangeland productivity as part of the Incentive Program, these benefits will be compensated to the producer as an adjustment to grazing charges (see Incentives Program description). This consideration is not included as a criterion in this study.

A variation of this consideration are the public values derived from private land investments and development. This variation is covered through criterion #1 as it relates to private range improvement investments.

13. Cultural/Minority Effects: In the estimation of market value using methods that incorporate various cost considerations, minority and cultural groups may be impacted excessively because of the higher costs of their comparatively small ranching operations. In these cases, grazing fees based on cost-related market values could adversely effect the heritage and cultural values of these minority groups, particularly in the Southwest. This consideration is not included as a criterion in this study.

14. Size of ranching operation: When forage value is calculated using producer costs, those costs must be based on an average of a number of different size ranch operations. To this extent, the problem of averages means that because small operators do not enjoy the economies of scale that larger operators have, small operations will be at a disadvantage relative to larger operators. This difference will be addressed through pricing area criteria to the extent such area boundaries reflect regional or local differences in average ranch size.

Methods of Valuing Public Land Forage

Because federal grazing fees are set by a formula¹ and not open market transactions between willing buyers and sellers, no direct estimate of market value is obtainable², and some indirect valuation procedures must be used. Past federal studies for studies have used several ways for alternative forage to indicate the apparent value of public land forage.

The formula used for the formula was established under the Public Rangeland Improvement Act (PRIA) of 1974. The formula is:

$$F = \frac{100}{100} \left(\frac{PPI - CPI}{100} \right)$$

The formula calculates the forage value established in 1966, and is adjusted by annual changes in private grazing and feed costs (PPI), cost of feed production (CPI), and price received for feed cattle (FCR).

¹As discussed above, the grazing permits are bought and sold in the competitive ranch and feed market. The market value of a grazing permit provides a direct estimate of the value of public land forage. Thus, an alternative method for estimating the value of public land forage is available from private values as well as legal grazing and livestock permits regulations, such as the Public Rangeland Improvement Act (PRIA) and the National Forest Management Act (NFMA).

CHAPTER II

APPROACH

The first task was an examination of methods used to value public land forage. The economic theory underlying the methods is presented, as well as the strengths and weaknesses of each. The examination of valuation methods concludes with a recommendation for the best method to value public land forage based on the defined criteria.

As forage valuation methods were examined, alternative pricing areas were developed. These were nationwide or westwide, states or regions, and local areas. Alternative ways to apply preferred valuation methods at each pricing level were explored. The market value of forage was the primary consideration.

Following the development of a recommended valuation approach and a recommendation of pricing areas, consideration was given to updating grazing fees. The GFTG recommends how often the basic valuation approach should be updated, and determines the need for short-term adjustments in grazing fees. The first recommendation reflects the need for major changes in valuation determination necessitated by changes in the market value of livestock forage. The second recommendation reflects minor adjustments in year-to-year variations in forage values.

Methods of Valuing Public Land Forage

Because federal grazing fees are set by a formula¹ and not open market transactions between willing buyers and sellers, no direct estimate of market value is obtainable², and other indirect valuation procedures must be used. Past federal grazing fee studies have used market prices for alternative forages to indicate the apparent value of public land forage,

¹The current grazing fee formula was established under the Public Rangeland Improvement Act (PRIA) of 1978. The PRIA fee formula is:

$$Fee = \$1.23 \left(\frac{FVI + BCPI - PPI}{100} \right).$$

The formula uses a \$1.23 base forage value established in 1966, and is adjusted by annual changes in private grazing land lease rates (FVI), costs of beef production (PPI) and prices received for beef cattle (BCPI).

²As discussed below, public land grazing permits are bought and sold in the competitive ranch real estate market. The market value of grazing permits provides a direct estimate of the value of public land forage. Thus, an observable market price for public land forage is available from permit values as well as legal leasing and livestock pasture agreements on federal lands (e.g. McGregor Range and Ft. Meade).

after making adjustments for the differences in services, facilities, and lease terms and conditions.

Several methods have been used or proposed for valuing public land forage. Some of these methods include market-price comparisons similar to that used by the federal government (Torell et al. 1989, Torell and Bledsoe 1990, Rimbey et al. 1992); competitive bidding for public land forage (Gardner 1963, USDA/USDI 1992, Gallacher 1992); economic production analyses (income approach), including ranch budgets and linear programs (Olson and Jackson 1975, Cook et al. 1980, Torell et al. 1981, Kehmeier et al. 1987); willingness-to-pay estimates (Hof et al. 1989); and amortized permit prices, whereby the observed market price (capital value) of federal grazing permits is amortized to estimate the annual forage value (Roberts 1963, Roberts and Topham 1965, Jensen and Thomas 1967, Torell and Doll 1991).

Theoretical justification for the various valuation techniques is based on the premise that ranchers are profit maximizers and the forces of supply and demand operate to establish range forage prices. If private and public forages are substitutes for each other then a rational and economically-motivated rancher should be willing to pay equal amounts for the two sources of forage. These principles were highlighted in economic models developed as a part of grazing fee research conducted in the 1960's at Utah State University (Roberts 1963, Jensen and Thomas 1967, Nielsen and Wennergren 1970).

The Utah Grazing Fee Model

The Utah grazing fee model is an application of the traditional production economic model for a profit maximizing firm producing one product with two variable factors of production. From this model it can be shown that forage has a derived demand in the production of livestock, and the forces of supply and demand establish range forage prices in the private forage market.

The Utah model assumes that ranchers face competitive input and output markets. Input prices include both fee and non-fee grazing costs. The input cost for private land grazing is comprised of forage value, non-fee costs (services) provided by the lessor, additional non-fee costs that must be incurred by the lessee, and an interest charge when the lease is paid in advance. Similarly, the cost of public land grazing includes the grazing fee, non-fee costs incurred by the lessee, an interest charge on the market value of the grazing permit, and an interest charge if the lease is prepaid.

As shown by Nielsen and Wennergren (1970), the Utah model implies the standard condition for profit maximization: profit maximizing firms use inputs up to the point where the marginal contribution of each factor in producing revenue, the value of the marginal product of factor i (VMP_i), is equal to the marginal factor cost of input i (MFC_i). This general condition, when applied to optimal forage use, implies that rational and

economically-motivated livestock producers should be willing to pay an input price equal to the value of forage in production.

The Utah model assumes private and public land forage are direct substitutes and that the marginal productivity of the two inputs are equal (Nielsen and Wennergren 1970). This implies that the amount a profit maximizing rancher should be willing to pay for the two types of forage would also be equal (Nielsen and Wennergren 1970). If public land forage is less productive than private forage, as is often argued, this productivity difference would have to be accounted for when defining production relationships. The importance of this assumption is that unless equal productivity and quality is assumed, valuation procedures that equate the cost of grazing public lands to the cost of grazing private lands are not valid and competitively negotiated private grazing leases cannot be used to indicate the apparent value of public land forage.

Forage Valuation Methods

The Utah model formed the basis for establishing the current PRIA fee formula. The model has also been used as the rationale for alternative forage valuation procedures. For these reasons it is important to evaluate what the Utah model implies about each of the major forage valuation techniques, including market-price comparisons, competitive bidding, economic production analyses, amortized permit prices, and contingent valuation procedures.

There are several limitations of all methods available for forage valuation. First, and most significant, is the variability in values derived using market comparisons. This variability has been detailed in past work (Nielsen 1972, Obermiller and Lambert 1984, Obermiller 1992, USDA/USDI 1986, 1992). Differences in ranching practices, ecological conditions, forage conditions, markets, and other factors assure that this variability does exist and that it is not just an estimation problem. Variability is apparent in both time (year-to-year variation) and space (ecological areas or regional differences in markets or practices). Ideally, this variability would be accounted for when valuing public land forage and would be reflected in area- or site-specific value estimates. Unless narrow definition of pricing areas is made, forage value estimates will be broadly defined averages and not site-specific.

Forage value implied from permit values or valuation using competitive bids are the only valuation methods that do not rely heavily on some type of survey to solicit information from ranchers about costs of production and production practices. Because of the emotional and political interest in the grazing fee issue, it may be difficult to gather unbiased survey responses. Even if the responses are valid, opposing interests will have room to question the validity of the survey results.

Each of the forage valuation methods described below theoretically estimates an economically efficient grazing fee and are consistent with the conditions of profit

maximization. However, each of the methods estimates these forage values by calculating average costs, rather than using the marginal analysis implied from the production economic model of optimal input use.

Market Price Comparison. The market price comparison method is based on the economic alternative cost doctrine whereby a rational lessee of forage will not pay in excess of the amount that must be paid for the next best alternative. The price paid for alternative forages in a competitive market can be used to imply the value of public land forage, provided adjustments are made to account for differences in non-fee grazing costs and lease arrangements.

Market price comparisons rely upon standards and procedures of professional appraisers to determine forage values. These valuation procedures, if properly applied should capture the true market value of forage negotiated between willing buyers and sellers in the marketplace. Comparisons between private and public land leases have recently been heightened by the political interest in grazing fees. A data base of private land lease rates (down to the state level) is currently available through USDA National Agricultural Statistics Service (NASS).

In many areas of the West, there are limited public and private forage leases for comparison and appraisal. For example, Custer County, Idaho is composed of 96 percent public land, and Nevada is 87 percent public land. Under these circumstances, it is difficult to obtain an adequate sample of private land leases to compare with public forage markets.

Private lands have traditionally been considered the next best alternative for public land ranchers. Private land lease rates were used to imply the value of National Forest lands as early as 1915 (Rachford 1924, p. 4). Recent federal grazing fee studies have relied exclusively on market price comparisons to establish forage value. Grazing fee studies conducted during the 1960's compared the total cost of grazing public and private lands (USDA/USDI 1977), whereas studies conducted in the 1980's (USDA/USDI 1986) and updated in 1992 (USDA/USDI 1992) used a market rental appraisal of private land leases, subleases, and other competitive public land leases to imply forage value.

Total Cost Approach. This procedure estimates the fee and non-fee costs of grazing on both private and public rangelands to provide an estimate of the net value of public land grazing. Total private grazing costs define the total amount willingly paid for grazing within a competitive market. Subtracting non-fee grazing costs on public lands from this amount results in an estimate of the amount that would equate total private and public grazing costs. Higher grazing costs on public lands because of location, distance, terrain, productivity, multiple uses and regulations are directly considered using the total cost approach to valuation.

The total cost approach was used to derive the \$1.23/AUM base charge in the current PRIA fee formula (USDA/USDI 1977). The total fee and non-fee costs of grazing

private and public rangelands were compared, using data collected by a 1966 Western Livestock Grazing Survey. The estimated difference in total grazing costs was considered to be the grazing fee that should be charged (USDA/USDI 1977, p. 2-22).

Market Rental Appraisal Approach. Theoretical justification for the market rental appraisal approach also comes from the Utah model. The major assumptions are that: 1) the private land lease rate can satisfactorily be separated using appraisal or statistical techniques to estimate the net value of private land forage, and 2) differences in lease terms and conditions can be accounted for in the lease comparison.

Non-fee costs for grazing public lands have been shown to be higher than on private lands. The implication is that the market appraisal approach will over-value public land forage by the amount that non-fee grazing costs on public lands exceed those costs on private lands unless adjustments are made for these non-fee grazing cost differentials. The analysis must either start with leases that are directly comparable in all factors affecting value (e.g. quality, access, level of improvement) or adjustments must be made for these differences.

To correctly use the market rental approach requires that estimates of non-fee costs be made for both private and public lands, and an adjustment made for any observed differential in costs. Non-fee costs must be gathered for both private and public lands, similar to the data requirements of the total cost approach.

The market appraisal approach has been widely criticized (Nielsen et al. 1985, Kearl 1989, Dudley and Rostvold 1992, Public Land News 1992). In addition to what are considered to be methodological problems with the data collection and analysis in recent federal grazing fee studies, the major criticism from industry is that private land lease rates do not provide a valid estimate of the value of public land grazing. This criticism is valid if non-fee grazing cost differentials and differences in lease characteristics are not correctly considered.

Permit Value. Historically, economists have claimed the fee charged to graze public lands has been less than the value of the forage and the rancher who controlled the grazing realized an economic value. Because control of grazing is embodied in the grazing permit, this value became a marketable item that has been transferred with the permit (Nielsen and Wennergren 1970).

Economists, including Roberts (1963), Gardner (1962, 1963), Jensen and Thomas (1967), Nielsen and Wennergren (1970), Torell and Doll (1991), Torell et al. (1992), and Workman (1988), have explored the theoretical reasons for permit value and have highlighted the importance of permit value to the grazing fee issue. Permit value has at least partially explained the apparent capitalized cost advantage that public land ranchers have over those grazing on private lands. As the cost differential between grazing public and private lands fluctuates, the changing value of the grazing permit theoretically

eliminates the cost advantage that public land ranchers have. When a public land rancher buys the grazing permit, total grazing costs are equated (Workman 1988, Torell et al. 1992).

The theoretical basis for using permit values to estimate forage value comes from the Utah grazing fee model described earlier. This economic model suggests a theoretical linkage between the level of grazing fees and permit value. As grazing fees or non-fee grazing costs fluctuate and thus change the differential between public and private grazing costs, permit values should adjust as well³. Theoretically, it is only at the fee level where permit value is zero or very near zero that the government is collecting full market value of the forage. As long as ranchers are willing to pay each other for the permit, the government is not extracting all the value of the forage (Nielsen and Wennergren 1970)⁴. An obvious equity question arises as to how or if ranchers should be compensated for the loss in their wealth position as higher grazing fees erode the value of public land ranches. Permit value remains a central issue in the grazing fee debate.

Because a competitive market exists for grazing permits⁵, a direct estimate of the annual value of public land grazing can be obtained by computing a rate of return on the grazing permit investment and adding this to the current grazing fee (Nielsen and Wennergren 1970). Differences in production, costs and returns between grazing allotments should be captured in the market value of public land grazing permits. Observed grazing permit values should give site-specific estimates of forage value while directly considering the costs, forage quality, range improvements, and characteristics of specific public land allotments.

Permit values can be determined from ranch sales data without surveying those who have a direct interest in the value estimate. Cost differentials, rules and regulations, and site-specific differences of leases are theoretically reflected as differentials in permit value.

³The theoretical linkage between grazing fees and permit value has not been widely observed on an empirical basis. After public land grazing fees increased from \$0.33/AUM to a base value of \$1.23/AUM in the 1960's, permit values continued to increase. Various market forces interact to determine value and permit value may have increased still more if grazing fees had not increased. Torell and Doll (1991) did find that as grazing fees on New Mexico state trust lands increased, capital values of grazing leases decreased. Yet, lease value for New Mexico state trust land has now increased to levels comparable with BLM and USFS permit values.

⁴It would be expected that grazing permits would maintain some value because of the long-term tenure of the permit and the seasonal complement that public forage provides.

⁵Gardner (1962) hypothesized that transfer restrictions for grazing permits including commensurate property and priority requirements impeded the market for grazing permits. Nielsen and Wennergren (1970) and Torell and Doll (1991) concluded that even with these transfer restrictions a reasonable amount of competition exists and that a relatively free market exists for public grazing.

If permit values arise only because of a capitalized cost advantage for public land grazing, this method should provide a direct and site-specific estimate of forage value. However, if permit values are influenced by factors other than expected livestock returns then valid estimates of forage value will not necessarily be obtained using this method. Jensen and Thomas (1967) found that factors associated with grazing cattle on public ranges explained only 55% of the variation in permit sales value. Similarly, Torell and Doll (1991) found that permit values have not provided a consistent estimate of the value of public land forage.

Another limitation of using the permit value approach is that forage values depend upon the selection of a subjective interest rate to use in the calculation. A minimal change in the interest rate chosen can produce a wide range of forage values.

A common method of determining the interest rate to be used in such studies is the capitalization of income approach. If a nearly constant net income level (A) is produced from an asset such as land and if constant real estate values (V) are realized, a capitalization rate (i) can be determined as $i = A/V$. This basic capitalization formula can be modified to account for changes in income levels, real estate values, inflation rates and uncertainty (Wise 1977, Burt 1986). The capitalization rate is analogous to a rate of return.

Klemme and Schoney (1984) stated that real cash returns to land typically range from 3 to 5 percent. Agee (1972) reported that real rates of return for Western cattle ranches estimated by several researchers from 1926-1968 ranged from negative values to 6.5 percent. More recently, Madsen et al. (1982) found earnings on investment for case study ranches in Colorado averaged 3.9 percent. Burt (1986) also determined the implicit real capitalization rate in Illinois to be 4 percent, while Gertel (1985) reported that the agricultural sector's rate of return to farm assets averaged 4.3 percent for 1960-1982. Adjusting the rate of return on AAA corporate bonds for inflation and an average weighted corporate tax rate, Row et al. (1981) determined the earning real rates on productive assets before taxes to be 3.6 to 3.9 percent and recommended the USFS use a 4 percent discount rate in long-term land and resource planning. Utilizing a hedonic valuation model, Torell and Doll (1991) reported a 3.35 percent capitalization rate for New Mexico ranches for 1979-1988.

Production Analysis. Various production function analyses and budgeting techniques can be used to estimate the value of public land forage (Bartlett 1983). However, range forage is only one variable input in range livestock operations and estimating the production function has not been done because of the complexity and variability in annual production relationships, and data limitations.

Enterprise budgeting is another production analysis technique for valuing public land forage. In this approach, the total gross value of the firm's (ranch's) output is calculated, and all costs except range forage are deducted. The remaining value is the residual return

to the grazing resource⁶. Dividing the residual return by the number of AUM's of grazing yields the apparent per unit value of the unpriced forage input (Bartlett 1983). The residual return is the economic return to the grazing resource once all other productive inputs have been paid a market rate of return.

Linear programming (LP) is a technique that has been used to analyze budget data (Gee 1983, Kehmeier et al. 1987). A linear profit function is defined for the ranch business, and this function is maximized subject to linear constraints that define seasonal resource limitations, forage use rates, production relationships, and transfer rates between the various production and sale activities. In addition to providing an estimate of what production scheme would maximize profit, LP provides an estimate of what an additional unit of each of the scarce resources would add to profit. This "shadow price" has been used to estimate the marginal value of forage for livestock production.

Production analyses can be used to derive forage values without data on private and public lease costs. However, ranch production cost data are still required. These approaches can be explicit to individual operators and conditions or can be developed for representative ranches and conditions over a broad area. Many enterprise budgets and LP analyses are available throughout the west from many different sources.

Because subjective values must be assigned to unpaid resources, the residual return to the grazing resource (the forage value estimate using this method) can vary greatly. Numerous budgets exist throughout the west with dramatic differences in the value assigned to the unpaid factors of production.

Competitive Bidding. Through a competitive bid, a direct market for public land forage would be created and the interaction of potential buyers and sellers would lead to discovery of the market value of public land forage. Those individuals with the highest potential value from the forage, and/or the lowest production costs, would bid the most for the forage and public land forage would be allocated to its highest and best use (assuming non-livestock users could also bid).

If a competitive bid system were used to establish forage value, the necessity to address pricing areas, ecological differences and administrative boundaries is removed. Variability in bids are expected due to the differences in lease conditions, quality, access, and production costs. It circumvents the ability to pay issue and should theoretically result in an efficient and equitable fee system.

Important policy issues must be addressed prior to instituting a bidding program. These include: What should be done with existing permit holders and the asset values of

⁶This is different than the standard budget analysis where grazing costs are included and a residual return is calculated to land, management, capital and risk. For forage valuation, a cost must be assigned to these other items.

these permits? Gardner (1962) suggested the government purchase existing permits and private improvement investments, with immediate enactment of a bidding system open to any livestock producer. Other concerns involve the terms of the lease, length of the lease period, who qualifies for submitting bids, commensurate property requirements, and provisions for minimum and maximum bids. Certain leases may have a limited number of prospective bidders (i.e., landlocked properties) and thus have little applicability to a bidding system. The validity and usefulness of competitive bidding in establishing forage values will be impossible to test, unless existing examples (e.g. McGregor Range and Ft. Meade) are used and results expanded westwide.

Contingent Valuation. In their recent review of grazing fees and public land management, Rostvold and Dudley (1992) suggest that the contingent valuation (CV) method be used to impute economic value derived from public lands. The CV method has received considerable attention in the resource economics literature and has been applied to many different goods, most commonly aesthetic and environmental improvements and recreational activities (Hof et al. 1989). CV studies have been utilized to value goods and services that are not exchanged in a market. Those who use a good or service are surveyed as to what they would be willing to pay for that good or service in order to derive the demand function. Hof et al. (1989) applied CV in four different formats to value public land forage. Price-response formats tended to result in either the current federal grazing fee or the private lease rate. This would appear to indicate that the respondents to the survey questions were very familiar with the grazing fee issue and might have biased their response on expected outcomes. Quantity response formats resulted in all or nothing bids. Using CV to value goods such as public land grazing may tend to result in biased responses by users who are dependent on the good for their livelihood and have a direct economic interest in the answers given.

Cost of Administration. No discussion of grazing fees would be complete without some mention of the cost of administering grazing programs. This discussion is necessary because many mention that the grazing fee on public lands should at least cover the cost of administration; in fact, it has been suggested that the fee be set according to the cost of administration.

The purpose of the valuation of public land forage is to arrive at the economic value of benefits ranchers receive by grazing public forage. The cost of administration approach is independent of the benefits derived from public land forage and is not a forage valuation method.

Recommended Forage Valuation Method

All of the above methods of valuing rangeland forage, except for basing grazing fees on the cost of administration, are consistent with profit maximization and justified on theoretical grounds. All valuation methods have specific limitations as discussed above.

The contingent valuation method can be discarded as a viable method because of response bias, where the respondent (public land rancher) has a vested interest in the derived values.

Market price comparison would be the preferred valuation method on theoretical and historical grounds. It has been widely accepted as a valid method of valuing forage. All cost items are explicitly defined and understandable. This method has also been criticized on the basis of relying on public land ranchers as the source for costs of grazing public lands.

Permit values provide a direct and site-specific estimate of forage value. Theoretically this estimate should provide a site-specific estimate of value while considering the inherent production characteristics, regulations, and economic potential of specific allotments. However, the procedure has not yielded consistent results, and permit values have been impacted by factors other than ranch economics, i.e., transfer restrictions, expected capital gains, and tax benefits (Jensen and Thomas 1967, Torell and Doll 1991, Martin and Jeffries 1966).

Production analysis requires subjective judgment in valuing ranch investments, labor, management, and risk. A wide range of forage values can be justified depending on values assigned to the above items. Data requirements are immense.

Competitive bidding would be the preferred alternative for setting grazing fees in the long run, because the market place remains the final arbiter of value, and the inherent differences in quality and productivity between grazing allotments would be accounted for in the bidding process. Theoretically, the market value of forage on each public land parcel would be collected. However, existing permit structure, regulations, and staffing would limit its immediate applicability. The equity question remains of whether existing permit holders should be compensated for permits and investments prior to instituting a competitive bidding system. Few opportunities exist to test this procedure in the short run, without dramatic changes in existing regulations and policies.

Recognizing the limitations of each of the methods, the criteria that total grazing costs on private and public lands should be equal, and our perception of what is possible, we consider market price comparison, permit valuation, and production analysis to be potential ways to value public land forage. Some type of market price comparison that adequately accounts for differences in non-fee grazing cost differentials and differences in terms and conditions of public and private leases would be the preferred valuation procedure. This method uses a competitive market to establish value, and it can be applied within the current permit allocation framework and with existing regulations. A major concern is whether valid estimates of value can be made given the controversies associated with the management of public lands and the grazing fee.

Pricing Areas

Concern has been voiced over geographic differences in public land forage values and grazing fees. It seems logical that more productive or higher quality rangelands would lease for more (Robertson 1978). Pricing areas have been suggested as a means of identifying these differences so that site-specific forage values and grazing fees could be determined. The purpose of this section is to identify potential pricing areas which will allow evaluation of the geographic differences in forage values.

Various pricing areas have been suggested over the years that are conceivably identified by taking into account different social, ecological, physiographic, economic and political factors. For example, Brownell and Tittman (1984) considered: 1) average county prices (economic), 2) natural vegetation which reflects the influence of soils, climate and land features (ecological), 3) physical or geographical features (physiographic), and 4) political and administrative boundaries. Other authors such as Nielsen and Williams (1970) have also recommended potential pricing areas based on the above criteria.

National or Single Pricing Area

The advantage of a single pricing area is the ease of value determination and administration, including periodic updating. The disadvantage is that as a nation-wide average some users will be overcharged while others will be undercharged. This holds true for all pricing areas other than individual allotments.

Regional Boundaries Based on Ecological Factors

The advantage of testing pricing areas based on ecological factors is that the elements perceived by many to support differences in forage value will be captured. These include, but are not limited to, range quality, season of use, climate, and other ecological considerations. The disadvantage of pricing areas based on these factors is the difficulty in establishing a precise boundary. Based on alternative boundaries included in studies cited in the following section, it is believed that a common boundary could be identified.

Past economic studies have found that quality of range does not necessarily equate to higher values in the market place (Robertson 1978). Grazing costs and estimated forage values could theoretically vary with size of permit, geographic area, type of livestock, season of use, and type of lease (i.e. BLM, USFS). Thus, these factors should theoretically be important in establishing forage value. However, studies by Nielsen (1972), Arthur D. Little, Inc. (1968), USDI-BLM (1968), and Houseman et al. (1968), using data collected in the 1966 Western Livestock Grazing Survey, did not support variable fees based on quality or regional variation.

In these earlier grazing fee studies, the size of permit or lease was found to have the strongest and most consistent correlation with grazing costs. However, differences between

private and public total grazing costs were found to be practically the same for all size classes, implying the same grazing fee should be charged (USFS 1968, p. 9). Similarly, these studies found area differences were not large enough in relation to sampling error and to the wide variation that existed within areas to provide a basis for varying grazing fees by pricing area (Nielsen 1972, Houseman et al. 1968). There was also no statistical justification for variations in fees between BLM and USFS. Earlier grazing fee studies supported only one base grazing fee for the West (USFS 1968, p. 9). However, the BLM/USFS appraisal (Brownell and Tittman 1984) supported variable fees, conceivably based on some of these same factors.

Administrative or Political Boundaries

The obvious advantage to pricing areas based on administrative or political boundaries is the positive definition of boundaries. From the standpoint of ease of administration, including updating fees, state boundaries would be the most appropriate. This would fit well with BLM's administrative structure and would potentially be adaptable to the USFS. Smaller political or administrative areas are essentially counties, BLM districts, BLM resource areas, National Forests (Supervisor's Office) and USFS Ranger Districts.

Local Areas

There have been suggestions and recommendations that the only fair way to value public rangeland forage is to appraise or value the forage at the allotment level. This valuation could be undertaken by individual negotiations or by indirect estimation procedures. By doing this all variables perceived to affect value would be considered (accessibility, lost animals, herding costs, maintenance, salting and feeding, effect of other public land users, etc.). Although this might be the fairest approach to each user, the process might be cost-prohibitive, because of the number of allotments or users involved (over 30,000). The GFTG did not test the feasibility of pricing forage at the individual allotment level.

Adjusting Forage Values Through Time

Forage markets are dynamic systems dependent on national, regional and local market conditions. Weather conditions, livestock numbers, livestock prices, and available seasonal forage substitutes are just a few of the factors causing annual and seasonal fluctuations in forage values. Brokken and McCarl (1985), in a comprehensive review of grazing fee policy, stated that: "An initially efficient equitable fee system will probably not remain so for more than a few years." This concern would appear to apply to any method of determining and updating grazing fees, with the possible exception of competitive bidding.

Various indices have been used or proposed for adjusting public land grazing fees through time. These include:

- FVI = The Forage Value Index, an index of private grazing land lease rates, as determined through an annual survey conducted by USDA/NASS.
- BCPI = The Beef Cattle Price Index, an index of prices of beef cattle over 500 pounds, as determined through an annual survey conducted by USDA/NASS.
- PPI = The Prices Paid Index, indexed prices that producers of livestock pay for selected production items, as calculated by USDA/NASS on an annual basis. This index does not include cost of living components, components of farm origin (feed, feeder livestock, seed and fertilizer) or taxes (USDA/USDI 1992, P. 28).
- ICI = Input Cost Index, a cost-of-production index that expands the cost items included in the PPI. This index includes livestock production costs of both farm and non-farm origin. Adding production items of farm origin is felt to better capture the trend in production costs actually realized by western ranchers. Thus, ICI has been proposed as a replacement for PPI (USDA/USDI 1992).

The inclusion of the BCPI and PPI in the PRIA fee formula, the functional form of the equation (e.g. additive, ratio), the accuracy of the various indices, the base period used for calculating the indices, and the interdependence and potential double counting when all three indices are used have been discussed at length (USDA/USDI 1977, 1986, 1992).

Testing Procedures

The Grazing Fee Task Group (GFTG) concluded that obtaining market value of the forage was the primary criterion to use in determining the grazing fee. An evaluation of alternative methods of valuing public land forage indicated that a comparison with the private forage market provides the best estimate of the market value of public land forage. This market comparison must consider the differentials in fee and non-fee grazing costs that exist between leasing private and public lands.

The GFTG also evaluated and established alternative pricing areas that could be used for determining fees. Limited studies were conducted by the GFTG as needed to test and evaluate different forage valuation systems and pricing areas. The objective of the evaluation was to provide information on the following topics:

- 1) Determine if the data is available (e.g. private land lease rates in areas of predominately public land areas) to apply market price comparison as a method of valuing public land forage.

- 2) Define the variability and necessary sample size required to expand cost data collection to other pricing areas if necessary.
- 3) Determine whether ranchers and others will provide data related to the grazing fee issue.
- 4) Evaluate if it is feasible to gather data in addition to that gathered in previous applications of market price comparisons (USDA/USDI 1986, 1992) to overcome weaknesses of these past studies.
- 5) Determine the costs, time, and skills required to establish a defensible value for public land forage in specific areas.
- 6) Provide an indication of the total number of allotments and areas that could be represented with a localized data set.
- 7) Evaluate if there are secondary data that could be used to estimate or corroborate estimates of forage value (e.g. state land grazing fee studies, NASS data, university studies).
- 8) Evaluate the extent to which methodologies could be applied to support a forage value estimate or use alternative methods to corroborate forage value estimates (e.g. permit value or existing ranch budgeting approaches).

Forage Value Evaluation

Ranch survey data were collected in Idaho, New Mexico, and Wyoming to identify public and private fee and non-fee grazing costs, similar to the 1966 Western Livestock Grazing Survey (USDA/USDI 1977). These states were selected to take advantage of the previous research on private grazing leases, ranch sales data and cost-of-production data collected as a part of state land grazing fee studies or university research efforts. Collected cost data were compared to university livestock enterprise budgets, updated cost data from the 1966 Western Livestock Grazing Survey using price indices (USDA/USDI 1992, Nielsen 1992a), and university grazing cost studies (Redmond et al. 1993, Obermiller 1992) where possible.

Non-fee grazing cost data were gathered on the cost items identified in the 1966 grazing fee study (Table II-1)⁷. Data on grazing permit investments (permit value) were also gathered. Range improvement investments (development depreciation) on public lands were determined from BLM and USFS records in the selected test areas. In addition,

⁷Appendix A provides additional detail about how costs were calculated and the specific assumptions that were made.

Table II-1. Description of non-fee cost categories.

Cost Category	Description
Lost animals	Value of livestock that die or disappear on the lease or allotment.
Association fees	Dues, fees and assessments by grazing associations.
Veterinary	Veterinary and medicine expenses for sick or injured animals grazing on the lease.
Moving livestock	Expenses to move livestock to and from the lease, including hired trucking, labor and vehicle expenses.
Herding	Labor and vehicle expenses to check on animals and to move livestock to new pastures or areas within the lease.
Miscellaneous labor and mileage	Labor and vehicle expenses to go to meetings, round up strays, or deal with various problems associated with the lease.
Salt and feed	Salt and feed expenses while livestock are on the lease.
Water	Cost of pumping and hauling water to the lease.
Horse	Cost of using horses on the lease.
Improvement maintenance	Labor, vehicle expenses, materials and equipment used to maintain improvements on the lease.
Development depreciation	
Federal land	Annual depreciation allowance for range improvements located on federal land and used on the allotment or lease. Only the rancher's share of cost is considered.
Private land	Annual depreciation allowance for range improvements located on private, state or other uncontrolled lands but used totally or partially on the allotment or lease. Only the rancher's share of cost is considered. Improvements used to service both private and federal lands are prorated based on the estimated percentage of use on the lease.
Other	Miscellaneous expenses including insect control, predator control and other undefined items.
Private lease rate	Fee paid to private lessors of forage for forage and services provided.
Total labor	Total labor costs summed across various categories defined above.
Total vehicle mileage	Total vehicle costs summed across various categories defined above.

ranchers interviewed in the survey defined still more range improvement investments that they had made on public lands and also detailed investments on private and state lands that also service federal allotments and private leased lands. Only the rancher's share of cost was considered and investments on non-federal land were prorated by the percentage of time or use on the federal allotment.

Ranch sales data and data collected by appraisers provided information on permit values in selected areas. Inclusion of amortized permit costs when making the cost comparison is controversial and was a major issue after the completion of the 1966 study. Legal precedent following fee increases in the 1960's found that action taken by the Secretaries of Interior and Agriculture to not consider permit value as a cost item and to raise grazing fees on this ground was proper (Pankey Land and Cattle Co. v. Hardin and Hickel, Cite 427 F.2d 43 1970). This legal finding does not make the investment in the grazing permit any less valid as a cost of grazing public lands and was considered in the collection of cost data.

Sampling Procedures. A random sample of public permittees and private lessees in the three states were interviewed to solicit estimates of fee and non-fee grazing costs. Personal interviews were used to gather data except for a few small private leases and follow up, which were covered by phone calls. The cost comparison required the respondent to evaluate the cost of using forage on only part of the ranch, i.e. a partial budget assessment of grazing costs on public land allotments or private leased lands. The partial budget analysis was thought to be too complex and subject to response bias to use telephone or mail surveys.

Federal Lands. Lists of public land permittees were obtained from BLM and USFS records. The BLM Denver Service Center provided a list of permittees in each of the test states from their data base. Lists of USFS permits were compiled by each ranger district. Lists were entered into a computer data base, with an identification number assigned to each permit/permittee. Individual state data bases were sorted by name and address to consolidate lists, accounting for those individuals with more than one federal grazing permit. Because some individuals, families, and corporations lease under different names, a complete consolidation was not possible.

State data bases were stratified based on AUM's of active preference, and three size groups of permits were defined (small, medium, large). The size groups were defined on the criterion that approximately one-third of the sampled AUM's from each land agency should fall within each size classification.

The number of BLM and USFS permits to be sampled was based on the proportion of AUM's leased by each land agency in each state (Table II-2). Based on the active grazing preference defined by the grazing lists, it was determined that BLM accounts for 59% of the federal land AUM's in Idaho, 69% in New Mexico, and 76% in Wyoming.

Private Lands. Lists of lessees of private forage were available from prior grazing lease surveys conducted in New Mexico and Idaho. Samples were drawn from these lists. A similar data base was not available in Wyoming. This required the development of a list of private leases from which to sample. Names of potential or known lessees of forage were gathered from USDA/NASS, stockgrower organizations, and county extension faculty. Due to limited numbers of leases, no stratification was undertaken for private leases. The list of ranchers identified as leasing private rangeland in each state was used as the sampling frame.

Sample Size. The desired number of permits or leases to sample in each state was determined using standard errors reported in the 1966 grazing cost survey (Houseman et al. 1968). This variation provided an estimate of expected variation that would be found in the 1992 survey. Standard statistical procedures were used to estimate desired sample size.

It was determined that each state would require a sample of 57 federal permits. Sample size was doubled in each state to account for potential non-response, inability to contact permittees/lessees and other factors. Table II-3 presents desired sample size (before doubling) by agency, size group and state. Sample size was allocated by size and land agency based on the percentage of total AUM's in each category.

Number of Ranchers Surveyed. Due to the detailed nature of the survey instrument (Appendix D), it was necessary to conduct the interviews mainly on a face-to-face basis with permittees and lessees. A few interviews were conducted by telephone.

Table II-2. Distribution of active preference (AUM's) by agency and test state, 1992.

State	Active Preference (AUM's)		
	BLM	USFS	Total
Idaho	1,369,410	952,565	2,321,975
percent	59	41	100
New Mexico	1,913,958	856,401	2,770,359
percent	69	31	100
Wyoming	2,002,950	629,581	2,632,531
percent	76	24	100
Total	5,286,318	2,438,547	7,724,866
percent	68	32	100

Source: Compiled from BLM and USFS databases defined by the BLM Denver Service Center and each USFS Ranger District or Regional Office.

Table II-3. Desired sample size by agency and test state.

Agency	Size	State		
		Idaho	New Mexico	Wyoming
BLM	Small	20	23	26
	Medium	8	8	9
	Large	6	8	8
	Total	34	39	43
USFS	Small	14	11	8
	Medium	5	4	3
	Large	4	3	3
	Total	23	18	14
Total Federal		57	57	57
Total Private		35	35	35

Surveys were conducted in the three states during October through December, 1992. The grazing cost survey was administered to 77 Idaho ranchers, 85 New Mexico ranchers, and 99 Wyoming ranchers. One public land lease in both Idaho and New Mexico were excluded from the analysis because the costs reported were about 3 times the next highest cost per AUM reported in the study. Both leases were small and the interviewers may have misunderstood and underestimated the herd size upon which costs were reported. In addition, one private land lessee with two leases in Idaho was excluded because only horses were grazed. This was not comparable to the other cattle and sheep leases considered in the analysis. After these exclusions, grazing costs were estimated with data supplied by 75 ranchers in Idaho, 84 in New Mexico, and 99 in Wyoming.

Figure II-1 presents the number of leases, by county and ownership (BLM, USFS, private) included in the final analysis for Idaho, Wyoming and New Mexico, respectively. The three-state data base included information on 173 BLM allotments, 72 USFS allotments, and 151 private leases. The total number of leases studied (federal and private) was 134 in Idaho, 113 in New Mexico, and 147 in Wyoming (Figure II-2). These totals were greater than the desired sample size because nearly all ranchers were willing to cooperate (low number of non-respondents), and many ranchers had more than one lease or grazing allotment. Grazing cost information was gathered on multiple leases/permits from most individuals to increase sample size at minimum cost.

Grazing costs were estimated for a total of 85, 66, and 99 federal grazing allotments in Idaho, New Mexico, and Wyoming, respectively. Of these, 19 provided grazing for sheep in Idaho, 6 for sheep in New Mexico, and 19 for sheep in Wyoming (Figure II-2).

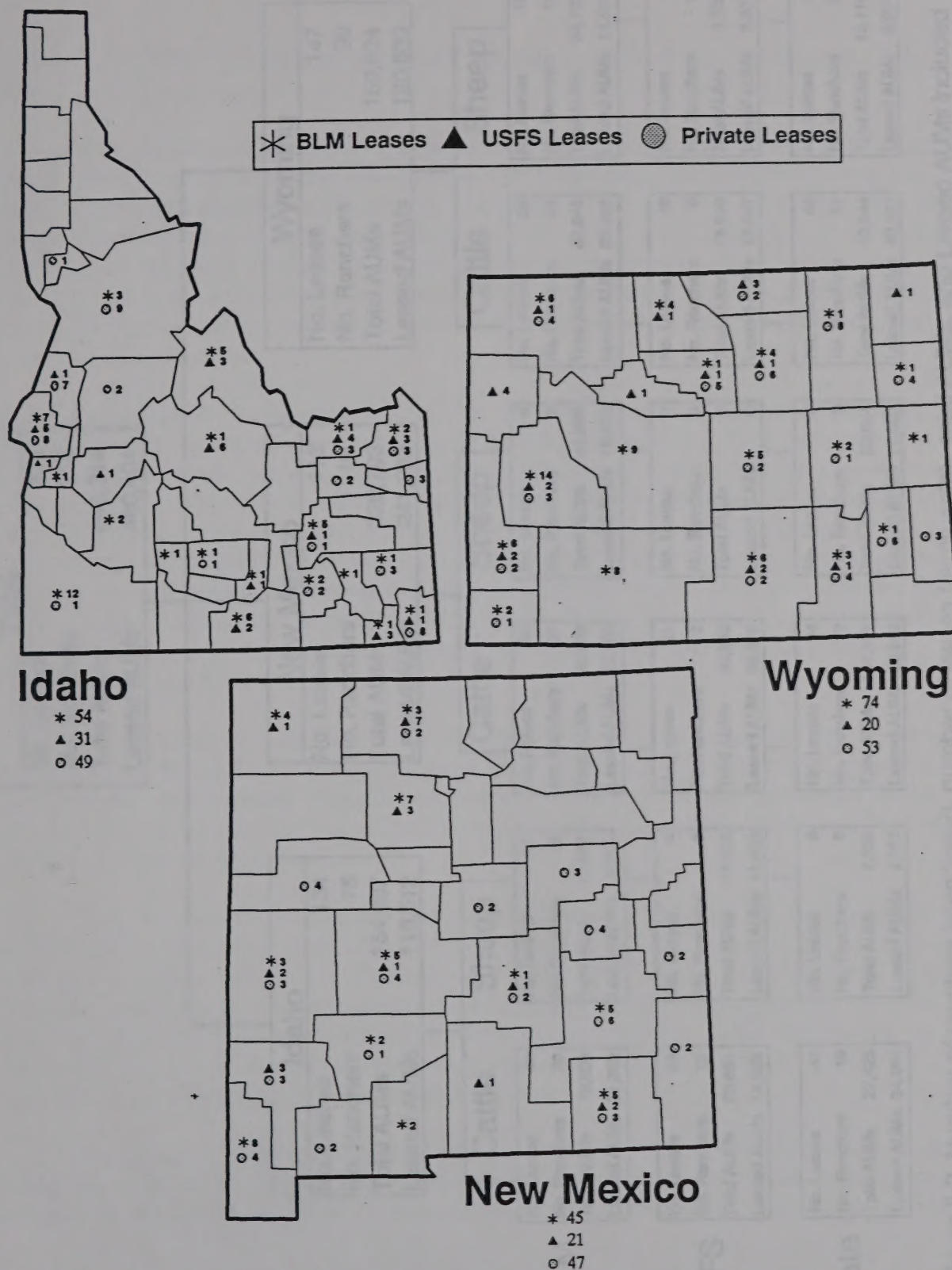


Figure II-1. Number of leases and allotments sampled by ownership, county and state.

Total			
No. Leases	394		
No. Ranchers	258		
Total AUMs	645,314		
Leased AUMs	480,404		

Idaho		New Mexico		Wyoming	
No. Leases	134	No. Leases	113	No. Leases	147
No. Ranchers	75	No. Ranchers	84	No. Ranchers	99
Total AUMs	154,687	Total AUMs	320,793	Total AUMs	169,834
Leased AUMs	118,512	Leased AUMs	241,253	Leased AUMs	120,639

	Cattle		Sheep		
	No. Leases	No. Ranchers	Total AUMs	Leased AUMs	
BLM	43	30	73,509	51,852	...
	11	6	11,897	8,339	
	39	30	86,629	45,182	
USFS	23	12	20,851	14,532	...
	8	5	13,653	11,453	
	21	13	40,288	38,938	
Private	46	19	27,425	24,984	...
	3	3	7,352	7,352	
	44	32	131,857	120,959	

	Cattle		Sheep		
	No. Leases	No. Ranchers	Total AUMs	Leased AUMs	
BLM	59	38	64,645	39,289	...
	15	13	34,102	14,562	
	6	6	41,395	18,672	
USFS	16	9	13,996	13,847	...
	4	3	3,333	3,333	
	0	0	0	0	
Private	44	31	40,644	40,644	...
	9	5	13,114	8,964	
	3	3	20,624	17,502	

Figure II-2. Number of ranchers interviewed, number of leases (allotments), total AUMs, and Leased AUMs included in the grazing cost survey.

Many of the sheep allotments also provided grazing for cattle during at least part of the year.

Sheep grazing on private rangeland was not common. Private leases included only 3 sheep leases in Idaho, 3 in New Mexico, and 9 in Wyoming. The sample size was too small to provide statistically valid grazing cost estimates for private land sheep leases when disaggregated to the state level. Also, sheep grazing costs on USFS lands in New Mexico could not be estimated because none were included in the sample. Only a broad estimate of forage value for sheep production was possible by combining data across all three test states. Recognition of limited sample size should be given when interpreting sheep grazing costs and forage values.

Statistical Analysis. Total grazing costs were calculated for each lease using the labor rates, mileage rates and other assumptions detailed in Appendix A. Total costs were converted to a \$/AUM value by dividing the total estimated grazing cost for each lease by the number of AUM's in the pasture or grazing unit. Non-fee grazing costs were spread over all AUM's on the allotment or lease, regardless of land ownership. In many cases, the total AUM's on the grazing unit was more than the total AUM's leased from federal land agencies or on private lands, because of other intermingled lands within the allotment or lease. Some of the allotments studied had very little federal land with most of the grazing capacity coming from state trust lands and private lands. This was especially true for Section 15 BLM allotments.

Grazing cost calculations and analysis were completed using appropriate statistical routines found in the SAS statistical program (SAS Institute, Inc. 1985, 1988). Variation in grazing costs were analyzed using an unbalanced⁸ analysis of variance (ANOVA) with a three-way design and interaction. A more complete description of the model used in the analysis is given in Appendix B.

The average cost reported for a particular state, livestock class and land ownership is not the simple average for each particular categorization. Rather, reported averages, along with standard errors (SE) of the estimates, were generated from the linear statistical model. Reported means are least-squares means (LSM), or population marginal means. A least-square mean was determined to provide the best estimate of value in this application because differences in the size of leases and sample size between states and classes of livestock were accounted for in the statistical model.

Forage value estimates are presented as mean values followed by 90% confidence limits about the mean. This procedure provides an estimated interval which is assumed to contain the true population mean at the specified level of confidence. This range of values

⁸In this context "unbalanced" refers to an unequal number of observations for different states, livestock classes and land ownership types.

gives additional information because it is highly unlikely that any particular sample mean will be exactly equal to the population mean that was estimated.

Permit Value Approach. Different methods were used to estimate grazing permit values in the three test states. First, in Idaho and Wyoming, ranch sales data were collected from Farm Credit Services (FCS) for the period 1986 through 1992. Summary statistics were compiled from 129 BLM and 38 USFS permit ranch sales in Idaho, and 290 BLM and 35 USFS sales in Wyoming. The data included ranches from all areas in Idaho and Wyoming and with varying levels of federal land dependency. Regional differences in value were not considered.

Sales data compiled included an appraiser's allocation of the contribution that public and state AUM's made to the market value of recent ranch sales. These estimates of permit value were recorded from FCS sales sheets and averaged over the 1986-92 period⁹. The reported averages were weighted by the number of federal AUM's leased.

Ranch values and permit values have been studied for a number of years in New Mexico (Fowler and Gray 1981; Torell and Fowler 1985, 1986; Torell and Doll 1989). Most recently, ranch sales data have been collected from FCS and regression analysis used to estimate the value of New Mexico ranches with different characteristics. Factors determined to influence value include the size of the ranch, rangeland productivity, and the percentage of grazing capacity coming from leased public and state trust lands.

Regression analysis similar to that used in earlier studies was used to estimate New Mexico grazing permit values. Ranch sales data for 1987 through March 1993 were collected from FCS. Data included sales price and definition of the terms and conditions of the sale. Data for 378 ranch sales from all parts of New Mexico and for all levels of federal and state land dependencies were included in the analysis. Average 1992 permit values were determined using the estimated regression equation¹⁰. This was done by estimating the January 1992 market value of a 300 AUY ranch totally dependent on BLM or USFS for grazing capacity.

Annual forage value was estimated by multiplying average permit values by a capitalization rate of 3.35% and adding this to the 1992 grazing fee of \$1.92/AUM. The result is the annual amount that ranchers have paid in the competitive ranch real estate market for public land grazing. Torell and Doll (1991) found that as grazing fees on New Mexico state trust lands increased from \$1.60/AUM in 1986 to \$3.13/AUM in 1989, the value of state land grazing leases decreased by \$29.81/AUM for every \$1/AUM increase in

⁹Averaging over the 6-year period was necessary to obtain an adequate sample size. This procedure is justified because the ranch real estate market was relatively constant over this time period.

¹⁰The regression equation updated statistical models developed by Torell and Doll (1989). The updated model is available from the authors.

the grazing fee. The implied capitalization rate was 3.35% (1/29.81). This rate is consistent with long-term rates of return realized from western public land ranches (Agee 1972, Madsen et al. 1982, Workman 1986). Obviously, estimated forage value will vary considerably depending on what interest rate is used. This is a limitation for using permit values to imply forage value.

Market Rental Approach. To provide a direct market-based check of the total cost approach, appraisers searched the market for comparable leases of public forage¹¹. To ensure a high degree of comparability, the market search was conducted in the same states as the total cost approach test--Idaho, New Mexico, and Wyoming. Market data were based on competitive bidding or negotiation within the normal bargaining of the market place, as opposed to those that are administratively set.

In addition to the limited number of competitive leases used as a market rental comparison, the data obtained from interviews with private land lessees included information on lease rates and terms and conditions of private land leases. The data included some leases where little if anything other than forage was provided with the lease and other leases where the lessor took care of the lessee's cattle on a daily basis. The variation in lease rates as lessors provided different bundles of services to the lessee was analyzed using regression procedures similar to Torell and Bledsoe (1990) and Rimbey et al. (1992). Dummy variables for major services including maintenance of the property, daily care of livestock, watering of livestock, and liability insurance were defined to be 1 when the lessor provided these services as part of the lease, 0.5 when they were done jointly by the lessor and lessee, and 0 when they were provided by the lessee. Additional dummy variables were used to test whether statistically significant differences existed between states. The private lease rate and non-fee costs were regressed against the defined dummy variables to estimate how the dependent variable changed as different combinations of services were provided. A more complete description of the regression model is provided in Chapter 3.

Pricing Area Evaluation

Estimated forage values were compared within and across potential pricing areas. This comparison evaluated the extent of homogeneity of forage values and allowed the testing of the total cost approach to display geographical sensitivity. Total grazing costs and forage values specific to local areas and conditions were identified and evaluated.

National or West-Wide Pricing Area. A single national fee has been used by the BLM since the implementation of the Taylor Grazing Act. In the USFS, a single fee has been

¹¹Following the standard appraisal definition used by the American Institute of Real Estate Appraisers (1983), market value of forage is considered to be the "most probable price in cash, terms equivalent to cash, or in other precisely revealed terms, for which public land forage would rent in a competitive market under all requisites to fair negotiation, with buyers and sellers each acting prudently, knowledgeably and with self interest."

used since 1969 in the western states. Past studies have focused at the national level. Indexing of values from previous studies were used to arrive at a current estimate of market value of public land forage. The GFTG did not collect new information on a national or westwide basis.

1966 Forage Value. The 1966 forage value of \$1.23 has been used in the PRIA formula with indexing tied to a base period of 1964-1968 (USDA/USDI 1977). The federal land agencies updated the 1966 forage value (\$1.23/AUM) using the ICI index described earlier (USDA/USDI 1992). The 1990 updated value was estimated to be \$2.93 or \$2.95/AUM depending on which states were considered (USDA/USDI 1992, Appendix A). Nielsen (1992a) also updated the value by indexing, but using individual indices (e.g. production items, wage rates, autos and trucks) for each cost item. The 1990 updated value using Nielsen's procedure was \$2.20/AUM. Indexed values were updated to 1992 for use in this report.

The validity of indexing procedures is questionable because the relationship between the physical inputs of grazing public forage as opposed to private forage sources very likely has changed over the past 25 years. The mix of uses on public lands has changed with more recreation and other multiple use activities prevalent today as opposed to 1966. More intensive grazing management is now practiced on both public and private lands. Livestock are generally hauled to the allotment instead of trailing as in 1966. Further, numerous policies have changed since the 1966 study; for example, the responsibility of maintaining range improvements has been passed almost entirely to the permittee. The condition and improvement of riparian areas has become a concern during the past decade. Also, numerous technological changes have occurred in livestock production and public resource management.

Because of these changes, the indexing procedure was tested against current cost estimates for grazing public and private forage. If the updated value from indexing is not statistically different from current value estimates determined through new cost studies in selected states, then the indexing procedure may provide valid estimates of current grazing costs and forage values. If indexed values are statistically different from new cost estimates, an expanded cost survey may be necessary to estimate and update forage values in all western states.

Forage Values from the 1992 Report. The 1986 grazing fee study by the federal land agencies reported a 1983 weighted average value for public land forage. This value was estimated to be \$5.99 per AUM in 1983 (USDA/USDI 1986, p.22). Criticism of this study has been that non-fee cost information was not collected and that appropriate statistical procedures were not followed in determining the value of forage in the six pricing areas. Nielsen (1992b) reexamined the data and estimated that the weighted value for public land forage should be 68 percent (\$4.07 per AUM) of the original values reported. Both the updated 1992 value and the Nielsen estimate were tested against present market value estimates.

NASS Private Lease Rates. NASS conducts surveys annually to determine the private land lease rate in the Western states. These estimates are used to determine the Forage Value Index (FVI) included in the PRIA formula. The GFTG evaluated whether this survey is appropriate to estimate private and public forage values at the state and national pricing area levels. This was done by testing whether there is a consistent differential between reported NASS lease rates and estimates of forage value. If a consistent differential does exist then annual forage values can be estimated by taking some percentage of annual NASS survey values.

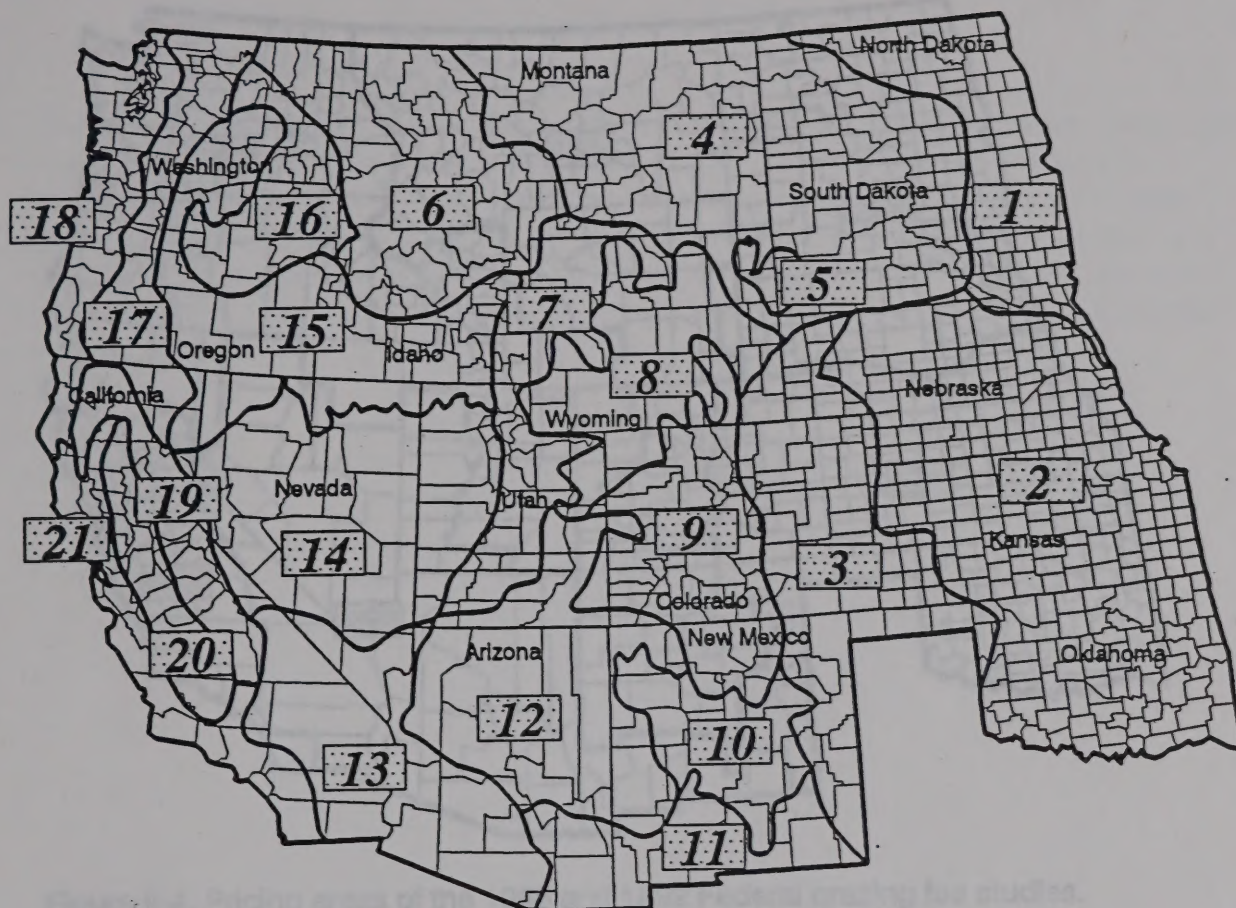
Regional Pricing Area. A regional pricing area can be established on the basis of ecological regions, economic regions, political boundaries or a combination of these factors. Regardless of the regional boundaries defined, it was appropriate to test several approaches for valuing forage through market price comparisons.

State Boundaries. States represent a feasible form of administrative boundary. They correspond with BLM administrative boundaries at the highest field level. Administrative boundaries that cross state lines, such as national forests, could be identified and assigned to a single state. Also, grazing allotments that cross state lines would need to be assigned in some manner.

Ecological Boundaries. Ecological boundaries represent areas differing in soils, vegetation, landform, climate, and use. Three ecological systems were reviewed. A composite set of ecological boundaries was developed from these three systems and used for testing differences in forage value. These ecological boundaries are shown in Figure II-3 and are based on the following classifications.

- a. Physiographic Regions. Defined by BLM (Brown and Kerr 1979). This system is based on potential natural vegetation.
- b. Ecoregions and Land Surface Forms of the United States. Defined by the U.S. Fish and Wildlife Service (USFWS) and U.S. Forest Service (Bailey 1978). This system is based on variations in climate, vegetation, and landform.
- c. Land Resource Regions and Major Land Resource Areas of the United States. Defined by the Soil Conservation Service (SCS 1978). This system is based on areas characterized by a particular pattern of soils, climate, water resources, and land uses. It is use-orientated and affords a basis for making decisions about agricultural concerns.

Pricing Areas. Grazing costs and forage values from the 3 test states were compared with 3 of the 6 pricing areas as shown in the 1986 Grazing Fee Review and Evaluation Study (Figure II-4). The purpose of this comparison was to evaluate whether lease rates and forage values determined here varied consistently with those reported in the 1986 grazing fee study (USDA/USDI 1986) and the 1990 fee update (USDA/USDI 1992).



Ecoregion Numbers and Their Descriptions

- | | | | |
|----|--------------------------------|----|------------------------------------|
| 1 | Central Lowlands | 12 | Colorado Plateau |
| 2 | Great Plains | 13 | Lower Basin and Range |
| 3 | Rocky Mountain Piedmont | 14 | Upper Basin and Range |
| 4 | Upper Missouri Basin and Range | 15 | Intermountain/Columbia Plateau |
| 5 | Black Hills Uplift | 16 | Palouse Grasslands |
| 6 | Northern Rocky Mountains | 17 | Cascade Mountains |
| 7 | Middle Rocky Mountains | 18 | Northern Pacific Border |
| 8 | Wyoming Basin | 19 | Sierra Mountains |
| 9 | Southern Rocky Mountains | 20 | California Subtropical Crop Region |
| 10 | New Mexico Plateaus and Mesas | 21 | Southern Pacific Border |
| 11 | Southern Desertic | | |

Figure II-3. Defined ecological boundaries.

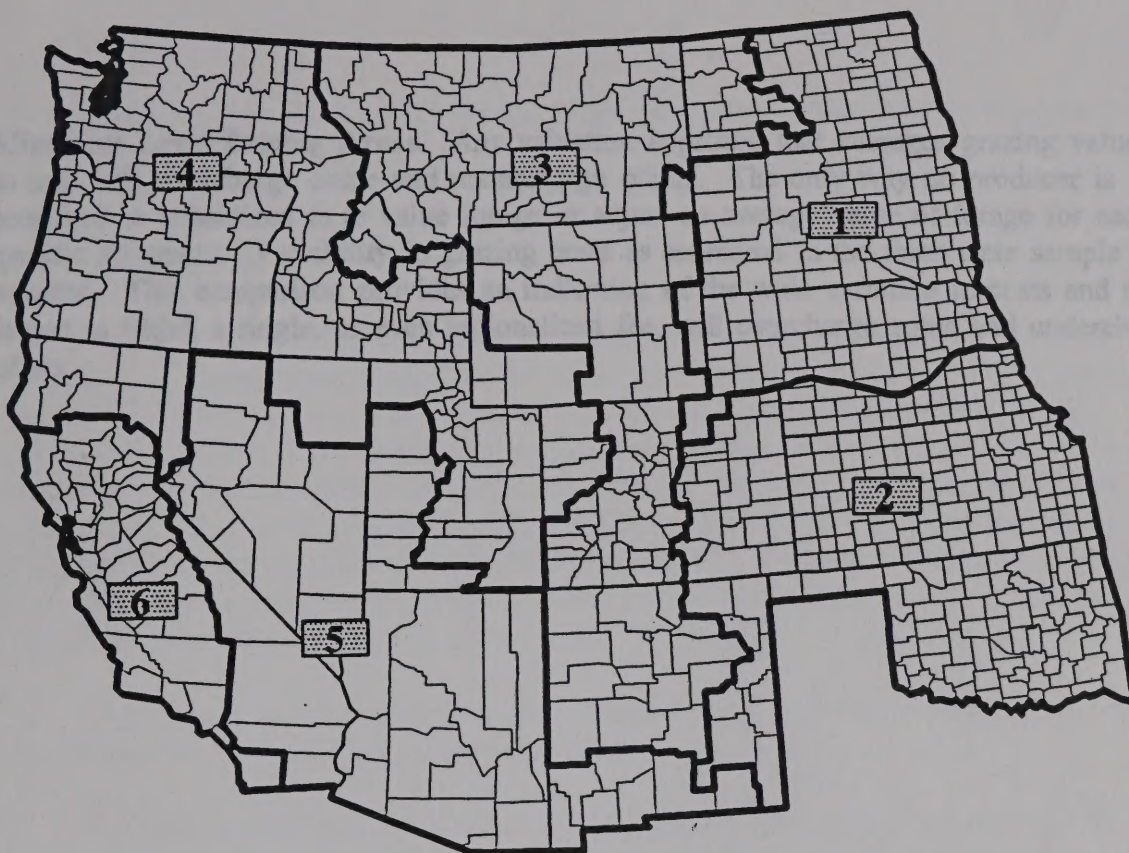


Figure II-4. Pricing areas of the 1986 and 1992 Federal grazing fee studies.

Allotment Level Pricing Areas. Any valuation approach that averages grazing value over an area will overcharge some and undercharge others. The only way no producer is penalized or subsidized is to value forage or adjust an average value of forage for each specific allotment. Variability in grazing costs as estimated in the three state sample are reported. This comparison provides an indication of the wide variation in costs and the degree to which a single, or even regionalized fee, will overcharge some and undercharge others.

In an evaluation where data from all states are combined, BLM and USFS grazing costs are combined, and all sizes of permits and leases are considered. Statistically significant differences were found, and a more detailed description of these differences is presented as the various classifications are described. Significant differences included variation in grazing costs by size of permit or lease, by state, type of livestock (sheep and cattle), and by land ownership (private, BLM and USFS). However, forage value, implied by the difference in total grazing costs between private and public lands, was not found to be significantly different except in a few areas.

In an evaluation of grazing cost data similar to that presented here but published in 1966, Monahan et al. (1966, p. 2) reported that:

"Variation among individual allotments of grazing cost per animal unit month (AUM) was very large within every category studied, namely, ranching area, season of use, and size of permit or lease. The strongest relationship found was the tendency for grazing cost to decrease as the size of allotment increased. Other relationships might have existed but could not be firmly established because of large random variation in the data. The wide variation of grazing costs among individual allotments should be interpreted as a reflection of the actual situation and not as an indication of inaccurate data."

This statement reflects our findings relative to grazing costs and size of permit, variability in grazing costs, and our evaluation of data reliability. Size of permit or lease was found to greatly influence grazing costs, as was expected. As shown in Figure III-4, small leases had the most variability in grazing costs, ranging from a low of \$1.26/AUM to a high of \$95.51/AUM. As size of lease increased, average cost and variability was reduced. This was true for all lease types studied (BLM, USFS and private lease).

Because lease size was found to be the major factor influencing grazing costs, and because lease size varied for different types of leases and permits, by state and by livestock class, it was important to account for the influence of size in the analysis. As further described in Appendix B, this was done by weighting the statistical model by the number of AUM's leased from each agency or from private lessors of forage. Further, grazing costs and forage value were estimated for various classifications of allotment size.

CHAPTER III

RESULTS OF FORAGE VALUATION AND PRICING AREA TESTING

Forage Values

Total Cost Approach

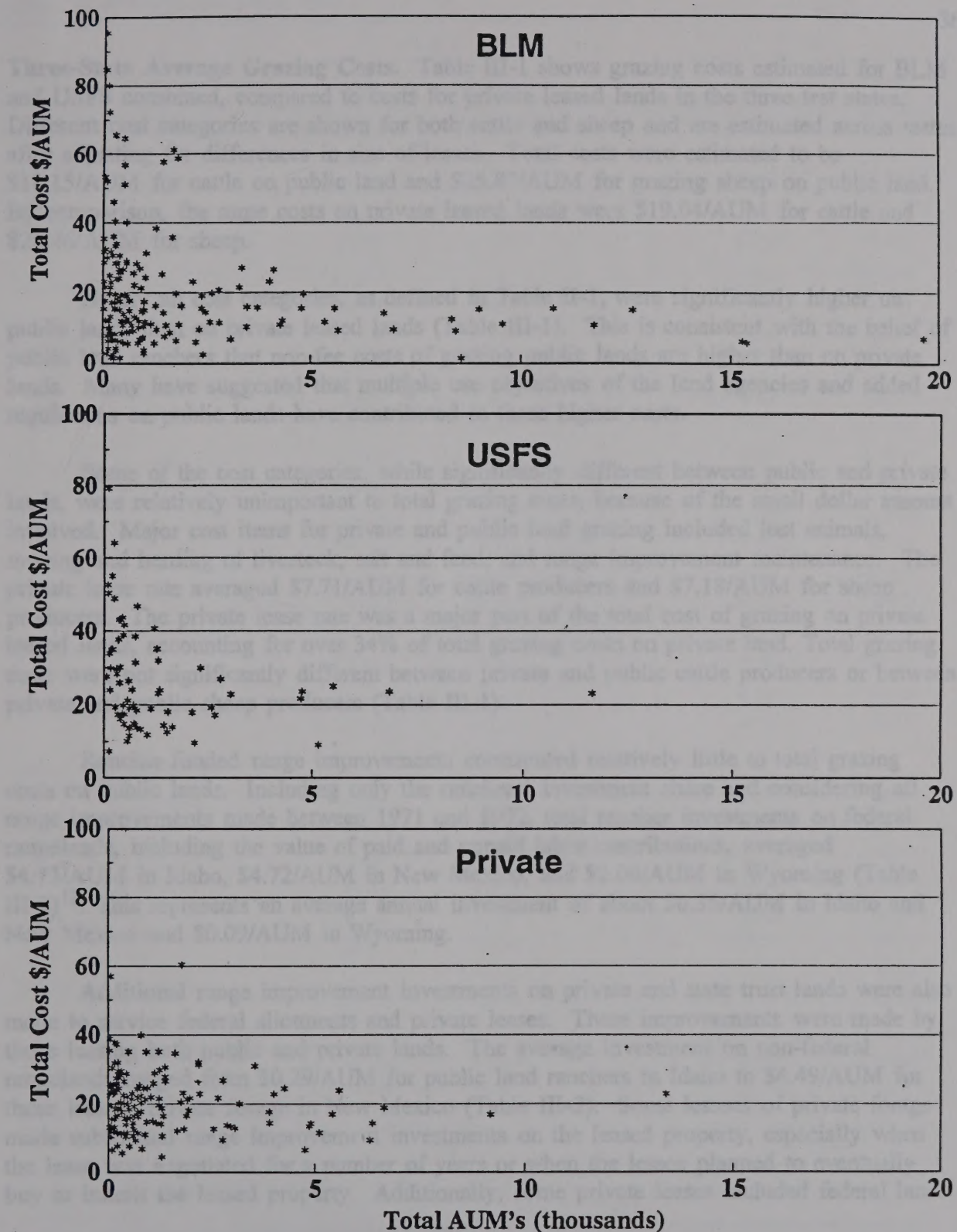
Results of the grazing cost survey are presented below, starting with the most aggregated evaluation where data from all states are combined, BLM and USFS grazing costs are combined, and all sizes of permits and leases are considered. Statistically significant differences were found, and a more detailed description of these differences is presented as the various classifications are described. Significant differences included variation in grazing costs by size of permit or lease, by state, type of livestock (sheep and cattle), and by land ownership (private, BLM and USFS). However, forage value, implied by the difference in total grazing costs between private and public lands, was not found to be significantly different except in a few cases.

In an evaluation of grazing cost data similar to that presented here but gathered in 1966, Houseman et al. (1968, p. 2) reported that:

"Variation among individual allotments of grazing cost per animal unit month (AUM) was very large within every category studied, namely, ranching area, season of use, and size of permit or lease. The strongest relationship found was the tendency for grazing cost to decrease as the size of allotment increased. Other relationships might have existed but could not be firmly established because of large random variation in the data. The wide variation of grazing costs among individual allotments should be interpreted as a reflection of the actual situation and not as an indication of inaccurate data."

This statement mirrors our findings relative to grazing costs and size of permit, variability in grazing costs, and our evaluation of data reliability. Size of permit or lease was found to greatly influence grazing costs, as was expected. As shown in Figure III-1, small leases had the most variability in grazing costs, ranging from a low of \$1.26/AUM to a high of \$95.51/AUM. As size of lease increased, average cost and variability was reduced. This was true for all lease types studied (BLM, USFS and private lease).

Because lease size was found to be the major factor influencing grazing costs, and because lease size varied for different types of leases and permits, by state and by livestock class, it was important to account for the influence of size in the analysis. As further described in Appendix B, this was done by weighting the statistical model by the number of AUM's leased from land agencies or from private lessors of forage. Further, grazing costs and forage value were estimated for various classifications of allotment size.



One private lease in New Mexico was larger than 20,000 AUMs and is not plotted.

Figure III-1. Total grazing costs on BLM, USFS and private leased land plotted against total AUMs in the grazing parcel, 1992.

Three-State Average Grazing Costs. Table III-1 shows grazing costs estimated for BLM and USFS combined, compared to costs for private leased lands in the three test states. Different cost categories are shown for both cattle and sheep and are estimated across states after adjusting for differences in size of leases. Total costs were estimated to be \$18.15/AUM for cattle on public land and \$25.87/AUM for grazing sheep on public land. By comparison, the same costs on private leased lands were \$19.04/AUM for cattle and \$20.46/AUM for sheep.

Nearly all cost categories, as defined in Table II-1, were significantly higher on public lands than on private leased lands (Table III-1). This is consistent with the belief of public land ranchers that non-fee costs of grazing public lands are higher than on private lands. Many have suggested that multiple use objectives of the land agencies and added regulations on public lands have contributed to these higher costs.

Some of the cost categories, while significantly different between public and private lands, were relatively unimportant to total grazing costs, because of the small dollar amount involved. Major cost items for private and public land grazing included lost animals, moving and herding of livestock, salt and feed, and range improvement maintenance. The private lease rate averaged \$7.71/AUM for cattle producers and \$7.18/AUM for sheep producers. The private lease rate was a major part of the total cost of grazing on private leased lands, accounting for over 34% of total grazing costs on private land. Total grazing costs were not significantly different between private and public cattle producers or between private and public sheep producers (Table III-1).

Rancher-funded range improvements contributed relatively little to total grazing costs on public lands. Including only the ranchers' investment share and considering all range improvements made between 1971 and 1992, total rancher investments on federal rangelands, including the value of paid and unpaid labor contributions, averaged \$4.73/AUM in Idaho, \$4.72/AUM in New Mexico, and \$2.00/AUM in Wyoming (Table III-2)¹². This represents an average annual investment of about \$0.35/AUM in Idaho and New Mexico and \$0.09/AUM in Wyoming.

Additional range improvement investments on private and state trust lands were also made to service federal allotments and private leases. These improvements were made by those leasing both public and private lands. The average investment on non-federal rangelands ranged from \$0.29/AUM for public land ranchers in Idaho to \$4.49/AUM for those leasing private forage in New Mexico (Table III-2). Some lessees of private forage made substantial range improvement investments on the leased property, especially when the lease was negotiated for a number of years or when the lessee planned to eventually buy or inherit the leased property. Additionally, some private leases included federal land.

¹²All ranchers had additional investments in the grazing permit and most ranchers had range improvement investments that were made prior to 1971.

Table III-1. Average grazing costs on public and private leased lands in Idaho, New Mexico and Wyoming combined (adjusted for differences in lease size), 1992.

	Cattle		Sheep	
	Public	Private	Public	Private
Sample size (n)	201	134	44	15
Lost animals	3.65 ^a (0.25)	2.10 ^b (0.29)	5.39 ^c (0.56)	2.63 ^{a,b} (0.90)
Association fees	0.48 ^a (0.07)	0.00 ^b (0.08)	0.04 ^b (0.15)	0.00 ^b (0.09)
Veterinary	0.10 ^{a,b} (0.03)	0.12 ^a (0.03)	0.22 ^a (0.06)	0.20 ^{a,b} (0.09)
Moving livestock	3.35 ^a (0.24)	1.93 ^b (0.27)	4.74 ^a (0.52)	2.51 ^{a,b} (0.83)
Herding	4.31 ^a (0.32)	2.94 ^b (0.36)	8.89 ^c (0.70)	3.05 ^{a,b} (1.13)
Misc. labor and mileage	0.69 ^a (0.06)	0.18 ^b (0.07)	0.77 ^a (0.13)	0.34 ^{a,b} (0.22)
Salt and feed	1.29 ^a (0.21)	1.80 ^a (0.24)	1.62 ^a (0.46)	1.53 ^a (0.75)
Water	0.39 ^a (0.06)	0.11 ^b (0.06)	0.39 ^a (0.12)	0.16 ^{a,b} (0.20)
Horse	0.31 ^a (0.03)	0.15 ^b (0.03)	0.47 ^c (0.06)	0.22 ^{a,b} (0.13)
Improvement maintenance	3.18 ^a (0.23)	1.84 ^b (0.26)	2.12 ^b (0.50)	2.22 ^{a,b} (0.81)
Development depreciation				
Federal land	0.33 ^a (0.03)	0.00 ^b (0.03)	0.17 ^c (0.06)	0.02 ^{b,c} (0.10)
Private land	0.12 ^a (0.04)	0.15 ^a (0.04)	0.09 ^a (0.08)	0.22 ^a (0.13)
Other costs	0.34 ^a (0.07)	0.11 ^b (0.08)	1.36 ^c (0.15)	0.35 ^{a,b} (0.25)
Private land lease rate	—	7.71 ^a (0.34)	—	7.18 ^a (1.07)
Total cost	18.15 ^a (0.82)	19.04 ^a (0.93)	25.87 ^b (1.80)	20.46 ^{a,b} (2.89)
Forage value	0.89 ^a ± 2.06 (1.26)		-5.41 ^a ± 3.52 (5.87)	
Combined cattle and sheep (weighted average) ¹	0.13			

Note: means on the same row that are followed by the same letter are not statistically different at the $\alpha = 0.10$ level. The number in parenthesis is the standard error of the mean. The individual cost items may not add up to the total cost because the mean for each cost item was estimated using an independent linear statistical model and is not the simple average for the cost category. Forage value is shown as the mean value with 90% confidence limits about the mean.

¹/Sheep and cattle were weighted by the proportion of leased AUMs included in the grazing cost survey, 88% cattle and 12% sheep.

Table III-2. Rancher-funded range improvement investments on federal and private lands from 1971 to 1992.

	Sample size (n)	Rancher Investments (\$/AUM)	
		Federal lands	Private/state lands
<u>Public land ranchers</u>			
Idaho	85	4.73 ^a (0.83)	0.29 ^a (1.09)
New Mexico	66	4.72 ^a (0.83)	3.54 ^{b,d} (1.09)
Wyoming	94	2.00 ^b (0.88)	1.16 ^{a,d} (1.16)
All States	245	3.82 (0.49)	1.66 (0.64)
<u>Private land ranchers</u>			
Idaho	49	0.06 ^b (1.36)	2.40 ^{a,b} (1.78)
New Mexico	47	0.90 ^b (0.83)	4.49 ^b (1.09)
Wyoming	53	0.00 ^b (1.19)	1.00 ^{a,d} (1.57)
All States	149	0.32 (0.67)	2.63 (0.87)

Note: Means in the same column that are followed by the same letter are not statistically different at the $\alpha = 0.10$ level. Means in the same row are not compared statistically. The number in parenthesis is the standard error of the mean.

Lessees did occasionally make investments on federal land in these cases.

Depreciation of range improvements on federal lands averaged \$0.33/AUM for cattle producers and \$0.17/AUM for sheep producers (Table III-1). This does not include a return or cost allowance for the investment in the grazing permit or range improvements made prior to 1971.

Cattle vs Sheep. As shown in Table III-1, the total cost of grazing sheep on public land was estimated to average \$7.72/AUM more than grazing cattle on public land and to be \$1.42/AUM more for private land sheep producers versus private land cattle producers. The total cost of grazing sheep on public lands was significantly higher than cattle. The grazing permit market bears out this finding. Vacant sheep permits can be obtained without purchase in many of the western states. Requests are routinely made to convert sheep permits to cattle permits (K. Lynn Bennett, BLM, Reno, NV, Personal Communication).

Sheep grazing costs were the most variable. Because of this variability and the relatively small sample size for sheep producers, especially on private lands, the confidence interval estimated for sheep forage value is over twice that estimated for cattle production (Table III-1). As shown in Tables III-3 and III-4, some of the variability is explained by state-level differences and by differences between BLM and USFS.

The number of sheep producers included in the survey becomes limiting when disaggregated to state levels and across BLM and USFS. Thus, caution should be used when interpreting the disaggregated numbers for sheep production. For example, sheep grazing costs are presented in Table III-3 by state, but we do not feel valid state-level comparisons of sheep production costs on private and public lands are possible, given the limited number of sheep producers included in the survey. Few sheep are produced on native rangeland that is privately leased. As such, it is not likely that the sample could be expanded to improve estimates of sheep grazing costs. The small number of private land forage users that produce sheep limits the potential to use the total cost approach to value forage for sheep production.

State Averages. Total grazing costs for cattle production were estimated to be highest in New Mexico, but only significantly higher for public land grazing (Table III-3). Most of the leases and allotments studied in New Mexico practiced yearlong grazing, compared with seasonal grazing in Idaho and Wyoming. Because New Mexico ranchers used the lease yearlong, it was common for shipping, weaning and calving to take place on the allotment.

Table III-3. Comparison of costs per AUM of grazing cattle and sheep on private and public land by state, 1992 (not adjusted for differences in lease size).

State	Cattle			Sheep		
	Private	Public	Public Forage Value	Private	Public	Public Forage Value
Idaho	17.10 ^a (1.87,46)	14.38 ^a (1.15,66)	2.72 ^a ± 3.45 (2.08)	21.40 ^a (3.44,3)	30.19 ^a (2.10,19)	-8.79 ^a ± 9.50 (5.52)
New Mexico	19.68 ^a (0.85,44)	20.16 ^b (1.02,60)	-0.48 ^a ± 2.32 (1.40)	21.93 ^a (2.23,3)	9.59 ^b (2.16,6)	12.34 ^b ± 6.37 (3.48)
Wyoming	17.22 ^a (1.46,44)	14.11 ^a (1.28,75)	3.11 ^a ± 3.34 (2.01)	17.93 ^a (3.12,9)	17.98 ^b (2.21,19)	-0.05 ^a ± 6.57 (3.86)
All states	19.04 (0.93,134)	18.15 (0.82,201)	0.89 ± 2.06 (1.26)	20.46 (1.80,15)	25.87 (1.80,44)	-5.41 ± 3.52 (5.87)

Note: Means in the same column that are followed by the same letter are not statistically different at the $\alpha = 0.10$ level. Means in the same row are not compared statistically. The numbers in parenthesis are the standard error of the mean and the sample size. Forage value is shown as the mean value with 90% confidence limits about the mean. State-level cost estimates were not adjusted for differences in lease size because sample size was limiting.

It was less common for these activities to occur on the seasonal grazing leases of the northern states.

Forage value for cattle production was not estimated to be significantly different between the three test states. Estimates ranged from $-\$0.48/\text{AUM}$ in New Mexico to $\$3.11/\text{AUM}$ in Wyoming (Table III-3). The 90% confidence limits ranged from negative values in all three states to $\$6.17/\text{AUM}$ in Idaho, $\$1.84/\text{AUM}$ in New Mexico, and $\$6.45/\text{AUM}$ in Wyoming. A complete listing of grazing costs by category is presented for each state in Appendix C.

BLM vs USFS. Cattle grazing costs were estimated to be higher on USFS land than BLM land in each of the three test states (Table III-4 and Appendix C). In fact, the average cost of grazing cattle on USFS lands was higher than private grazing costs in Idaho and New Mexico, and when averaged over all three states. This implies a negative forage value for USFS grazing in these cases ($-\$3.78/\text{AUM}$ in Idaho, $-\$5.13/\text{AUM}$ in New Mexico, $+\$2.13/\text{AUM}$ in Wyoming, and $-\$2.26/\text{AUM}$ when averaged across all three test states). This is similar to what Obermiller (1992) found for eastern Oregon where USFS was found to be the most expensive lease, followed by private and then BLM.

The 1966 grazing cost survey did not find USFS grazing costs to be higher than private land leases when averaged across all forests and BLM districts. Similar to our findings, the 1966 survey found positive average forage values for USFS lands in Wyoming but negative forage values for several Forests in Idaho and New Mexico. The 1966 study did find the average cost of grazing USFS land was $\$0.62/\text{AUM}$ higher than BLM land, but this difference was not significant. Houseman et al. (1968) reported that after adjustments were made for season of forage use and differences in size of permits between the two agencies, the adjusted USFS cost was only $\$0.08/\text{AUM}$ higher than for BLM. The difference in cost was no longer significant (Houseman et al. 1968, p. 2). By comparison, after we adjusted for size differences¹³, USFS grazing costs were still significantly higher.

As shown in Appendix C, major cost categories explaining the higher cost of grazing USFS lands included lost animals, association fees, moving and herding of livestock, miscellaneous labor, vehicle expenses and horse costs. Other cost categories, including miscellaneous expenses and development depreciation on federal lands, were significantly higher on USFS in some cases but did not greatly contribute to the higher cost of USFS grazing.*

Several explanations are possible for the relatively high cost estimated for grazing USFS lands, and the negative estimate of forage value for these lands.

¹³ While data were collected on season of use for each lease and allotment, within the time frame of this study, we were not able to evaluate whether significant differences existed for different seasons of forage use.

It was the average for each category of land on the standard grazing basis of 2.5
acres per acre.

Private values for each category of land were estimated to be slightly higher than
between the three test states. (Private values were \$24,000 in New Mexico, \$23,100 in Wyoming,
and \$21,000 in Wyoming. The 1972-1973 continuous studies ranged from \$21,000 to \$24,000 in New Mexico,
and \$21,000 to \$24,000 in Wyoming. A composite figure of grazing costs by category is presented for
each state in Appendix C.)

1972 vs 1973. Private grazing costs were estimated to be higher on USFS land than BLM
land in each of the three test states (Table III-4 and Appendix C). In fact, the average cost
of grazing cattle on USFS land was higher than private grazing costs in each of the three
states, and when averaged over all three states. This implies a significant difference in the
1972 grazing costs (Table III-4) when averaged across all three test states.
This is similar to what O'Rourke (1977) found for private grazing costs (USFS was found
to be the most expensive state, followed by private and then BLM).

The 1972 grazing cost survey did not find USFS grazing costs to be higher than
private land costs when averaged across all three test states. However, in each
state, the 1972 survey found private grazing costs were higher than USFS costs in Wyoming,
but private grazing costs were higher than USFS costs in New Mexico. The 1972 study
did find the average cost of grazing USFS land was \$24,000 higher than BLM land, but
this difference was not significant. However, it is (1972) reported that the difference
was not significant for cattle and horses and differences in size of herds between the two
agencies. The estimated USFS cost was only \$24,000 higher than BLM. The
difference in cost was not statistically significant (Appendix C, Table III-4). The
costs were adjusted for size differences¹². USFS grazing costs were still significantly higher.

As shown in Appendix C, private cost categories explained the higher cost of
grazing USFS lands included less wildlife, less water and timber, and
less recreational value, which explains and partly costs. Other cost categories
including infrastructure, and development, and development on federal lands, were
significantly higher on USFS in some cases but did not greatly contribute to the higher cost
of USFS grazing.

Several explanations are possible for the relatively high cost estimated for grazing
USFS lands and the negative estimates of range values for these lands.

¹² While costs were collected on a basis of one acre per cow herd and adjusted for size of herds, the data were not adjusted for differences in herd size between the three test states.

Table III-4. Comparison of total grazing costs per AUM for grazing cattle and sheep on private, BLM and USFS lands, 1992.

State	Cattle					Sheep				
	Private	BLM	BLM Forage Value	USFS	USFS Forage Value	Private	BLM	BLM Forage Value	USFS	USFS Forage Value
Idaho	17.10 ^a (1.80)	12.55 ^a (1.25)	4.55 ^a ± 3.69 (2.22)	20.88 ^{a,b} (2.36)	-3.78 ^{a,b} ± 5.09 (3.04)	21.40 ^a (3.32)	32.32 ^a (3.12)	-10.92 ^a ± 11.16 (6.34)	28.64 ^a (2.66)	-7.24 ^a ± 8.69 (4.85)
New Mexico	19.68 ^a (0.82)	16.16 ^b (1.34)	3.52 ^a ± 2.54 (1.53)	24.81 ^b (1.44)	-5.13 ^a ± 2.58 (1.55)	21.93 ^a (2.15)	9.59 ^b (2.09)	12.34 ^b ± 6.14 (3.35)	*	*
Wyoming	17.22 ^a (1.41)	13.76 ^a (1.44)	3.46 ^a ± 3.43 (2.07)	15.09 ^c (2.42)	2.13 ^b ± 4.60 (2.76)	17.93 ^a (3.01)	16.28 ^c (2.36)	1.65 ^a ± 6.82 (4.01)	25.40 ^a (4.93)	-7.47 ^a ± 8.60 (4.86)
All states	19.04 (0.88)	15.41 (0.99)	3.63 ± 2.42 (1.47)	21.89 (1.30)	-2.86 ± 2.59 (1.58)	20.46 (2.74)	23.23 (2.19)	-2.77 ± 6.22 (3.71)	32.68 (3.00)	-12.22 ± 6.94 (4.07)

Note: Means in the same column that are followed by the same letter are not statistically different at the $\alpha = 0.10$ level. Means in the same row are compared statistically in Appendix C. The number in parenthesis is the standard error of the mean. Sample size is given in Appendix C. Forage value is shown as the mean value with 90% confidence limits about the mean. State-level cost estimates were not adjusted for differences in lease size because sample size was limiting.

* Inadequate data to estimate.

1. The estimate of cost is correct and USFS permittees are in fact spending more to graze than their counterparts leasing private lands. Any differentials in grazing costs should be equalized by differences in grazing permit value. When permit value is considered (which it has not been in the above comparison), total grazing costs between land types should be equalized (see pages 11-12). Rational, profit-motivated ranchers should not be willing to pay more for grazing on public lands if lower cost alternatives exist in the private forage market. The total cost approach may not capture all elements of value associated with USFS permits. For example, USFS permittees may be willing to pay higher costs to graze in scenic, remote areas and maintain a way of life (Smith and Martin 1972, Young and Shumway 1991, Bartlett et al. 1989).
2. Private leases included in the grazing cost survey are considered to be comparable to BLM and state trust lands with respect to proximity and physical characteristics. However, few of the leases were in the mountains and directly comparable to USFS lands. The survey included twice as many BLM leases as compared to USFS (Figure II-1), and the sample size for USFS may not have been adequate to derive valid estimates of value. However, it was not just a few high-cost USFS leases that raised the average. Rather, grazing costs were significantly higher for USFS and costs were generally higher than BLM or private costs for all size categories. In New Mexico, some of the increase in costs could be explained by cultural differences and the high value placed on the agrarian way of life. Of the 21 USFS ranchers interviewed in New Mexico, 10 had relatively small sized cow herds and were Hispanic ranchers, mostly in north-central New Mexico. Grazing costs were higher for these individuals, especially the value of unpaid family labor.
3. Market price comparisons for valuing forage assume ranchers have numerous alternatives available to them. Private and public forage are assumed to be direct substitutes. Yet, in reality, most public and private forage remains leased and some ranchers are forced to use higher cost alternatives if they want to be in the livestock business¹⁴.

Estimated forage values for cattle grazing on BLM land -- \$4.55/AUM in Idaho, \$3.52/AUM in New Mexico and \$3.46/AUM in Wyoming -- were not significantly different between states. This suggests that the average forage value estimated across all three states, \$3.63/AUM, can be used as a single value estimate for all three states.

¹⁴The traditional economic model of profit maximization suggests that those leasing forage carefully evaluate the marginal economic benefit of each leasing alternative. We do not imply, however, that the ranchers we interviewed knew their grazing costs, let alone the cost and profit potential for alternative forage leasing options. Many of the public land ranchers participating in the survey indicated a perception that their costs were higher than those leasing private lands, but they had not done an economic assessment of grazing costs and profit maximizing alternatives.

Sheep grazing costs were higher and more variable (Table III-4). Estimated forage values on BLM land ranged from -\$10.92/AUM in Idaho to +\$12.34/AUM in New Mexico. Forage value on USFS land was estimated to be -\$7.24/AUM in Idaho and -\$7.47/AUM in Wyoming. However, these estimates are based on an inadequate sample size, and we do not believe that forage values for sheep grazing can be estimated by comparing to the private forage market unless additional sheep leases can be found and analyzed.

Allotment Size. The size of the allotment or lease was found to be the major factor affecting grazing costs (Figure III-1). Computing average costs weighted by the number of AUM's leased removed much of the variation caused by economies of size. Adjusting for differences in lease size between private and public lands using arbitrary size classifications generally increased the costs estimated. As shown in Table III-5, weighted average grazing costs tended to decrease as size of the allotment or lease increased. The classification with less than 500 AUM's on the grazing parcel had the highest grazing costs. In most cases, grazing costs for this smallest size category were significantly higher than the larger size categories. The spread in average grazing costs between the smallest and largest size classification generally exceeded \$7/AUM. For sheep grazing on BLM and USFS lands, the difference in grazing costs between those with less than 500 AUM's on the grazing parcel and those with over 3,000 AUM's was over \$20/AUM (Table III-5).

Forage value was estimated to be the least for the smallest allotments, as might be expected. However, forage value did not consistently increase as size of lease increased. Forage value was not estimated to be significantly different between most of the size classifications, but grazing costs were significantly less for larger leases and allotments. This same result was reported in the 1966 grazing cost survey:

"Although size of permit is the strongest and most consistent factor explaining the cost per AUM, it does not appear to be a good factor on which to vary the fee. A straight line regression shows that the difference between private and combined public total costs are practically the same for all size classes. The cost difference for the permittee with less than 200 AUM's is (only) 7 cents more than for the permittee with over 5,000 AUM's per permit" (USFS 1968, p. 9).

Differences in allotment size and type of livestock managed on USFS and BLM allotments were important factors explaining variation in grazing costs and forage value. Cattle forage value was estimated to be \$3.63/AUM and -\$2.86/AUM for BLM and USFS, respectively, when all data were combined and variation in allotment size and other class variables were considered. Sheep forage values were also reduced relative to those

Table III-5. Comparison of total grazing costs per AUM for grazing cattle and sheep on private, BLM and USFS lands with various size (S) classifications of total AUMs on the grazing parcel, 1992.

AUM Size (S) Category	Cattle					Sheep				
	Private	BLM	BLM Forage Value	USFS	USFS Forage Value	Private	BLM	BLM Forage Value	USFS	USFS Forage Value
S ≤ 500	21.55 ^a (2.37,60)	20.00 ^a (2.68,66)	1.55 ^{a,b} ± 5.99 (3.69)	29.80 ^a (3.33,26)	-8.25 ^a ± 7.00 (4.22)	21.11 ^a (8.32,4)	34.99 ^a (6.39,9)	-13.88 ^a ± 19.69 (11.13)	45.36 ^a (7.85,4)	-24.25 ^a ± 21.28 (11.44)
500 < S ≤ 1000	19.52 ^a (2.01,27)	13.76 ^b (2.27,28)	5.76 ^{a,b} ± 5.11 (3.04)	22.65 ^{a,b} (2.92,15)	-3.13 ^a ± 5.75 (3.46)	19.17 ^a (5.71,3)	21.20 ^b (5.05,7)	-2.03 ^a ± 15.72 (8.68)	30.16 ^{a,b} (6.11,3)	-10.99 ^a ± 16.22 (8.36)
1000 < S ≤ 3000	20.65 ^a (1.25,33)	15.25 ^{a,b} (1.60,26)	5.40 ^b ± 3.34 (2.00)	19.53 ^{b,c} (1.91,13)	1.12 ^b ± 3.91 (2.33)	22.24 ^a (3.86,3)	26.13 ^{a,b} (2.72,8)	-3.89 ^a ± 9.12 (5.06)	30.93 ^b (3.55,4)	-8.69 ^a ± 10.04 (5.30)
S > 3000	14.42 ^b (1.16,14)	12.65 ^b (1.01,20)	1.77 ^a ± 2.62 (1.55)	15.58 ^c (2.43,6)	-1.16 ^{a,b} ± 4.06 (2.36)	19.31 ^a (1.78,5)	10.61 ^c (1.78,8)	8.70 ^b ± 4.72 (2.67)	24.28 ^b (4.38,1)	-4.97 ^a ± 8.46 (4.36)
All sizes	19.04 (0.88,134)	15.41 (0.99,141)	3.63 ± 2.42 (1.47)	21.89 (1.30,60)	-2.86 ± 2.59 (1.58)	20.46 (2.74,15)	23.23 (2.19,32)	-2.77 ± 6.22 (3.71)	32.68 (3.00,12)	-12.22 ± 6.94 (4.07)

Note: Means in the same column that are followed by the same letter are not statistically different at the $\alpha = 0.10$ level. Means in the same row are not compared statistically. The numbers in parenthesis are the standard error of the mean and the sample size. Forage value is shown as the mean value with 90% confidence limits about the mean. Sample size precluded using contrasts to evaluate statistical differences between forage value estimates; differences were estimated using confidence limits.

estimated in Table III-4 where allotment size was not included in the model¹⁵.

When compared to BLM allotments, grazing costs on USFS were found to be significantly higher¹⁶. It is not justifiable to combine data from the two land agencies. However, it is interesting to note the estimated 1992 forage value that is comparable to the PRIA base value of \$1.23/AUM. As shown in Table III-1, forage value when USFS and BLM were combined, was estimated to be \$0.89/AUM for cattle and -\$5.41/AUM for sheep. The weighted average forage value combining cattle and sheep is \$0.13/AUM¹⁷.

Dispersion of Individual Forage Values. The variability of average forage values obtained from the total cost approach is reflected in the large standard errors of the estimates. This variability can be further examined in Figures III-2 and III-3, which show cumulative distributions of forage value for the individual allotments in the three state test area. The individual forage value was determined by subtracting the total cost per AUM of each allotment from the private lease rate corresponding to the allotment's size as shown in Table III-5. Forage value is shown separately for cattle and sheep, and for both BLM and USFS allotments. Approximately 30 percent of BLM cattle allotments, 50 percent of USFS cattle allotments, 50 percent of BLM sheep and 90 percent of USFS sheep allotments have forage values less than \$0.00/AUM. These individuals have paid more than private lessees for forage before the grazing fee or permit investment is considered. This is because for these individuals non-fee grazing costs are high relative to comparably sized private leases. All of the cost distributions are fairly steep after they reach a zero forage value. For example, 40 percent of all BLM cattle allotments have forage values between \$0.00/AUM and \$10.00/AUM (Figures III-2 and III-3).

The variability in forage value for individual allotments can be attributed to several factors. First, ranchers were asked to state their costs for the 1992 grazing season. The intent was that while some of the rancher's 1992 costs may be below average, others would be above average and thus would equal out. Secondly, the variability in costs can be attributed to the differences in the productivity and distances of the leases from the ranch headquarters. Third, economies of size have been shown to exist. Individual allotments with large negative forage value were mainly smaller allotments.

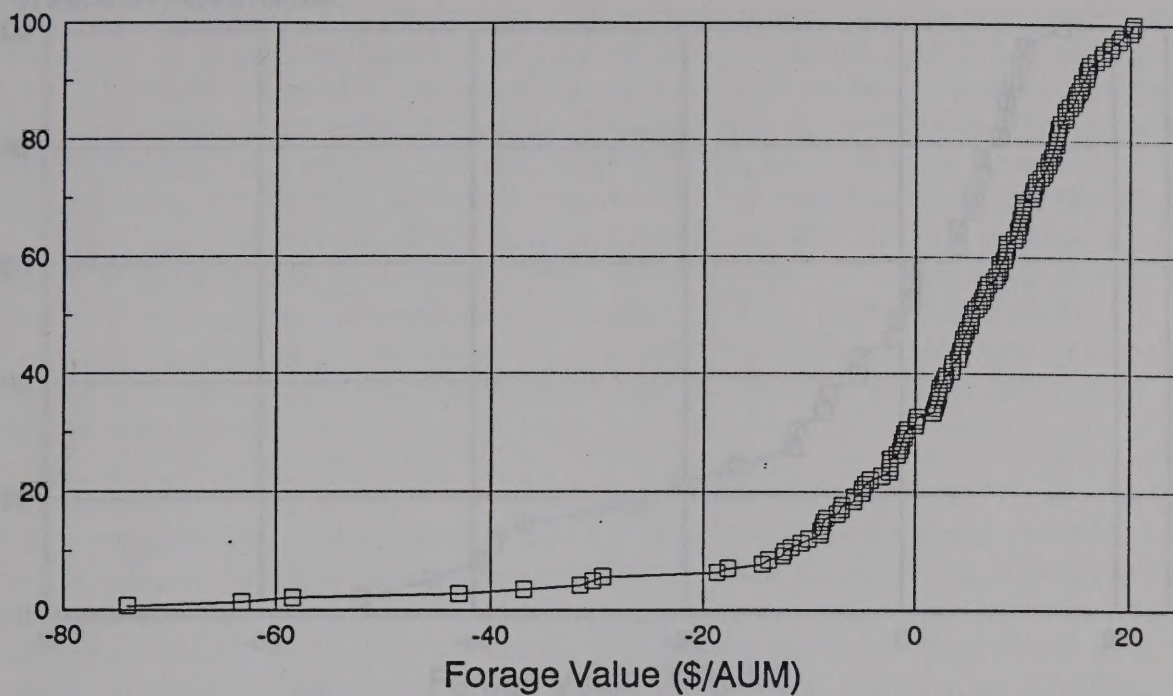
¹⁵The GLM model (Appendix B) used to estimate the grazing costs and forage values reported in Table III-5 included state, livestock type (cattle or sheep), land ownership (BLM, USFS or private lease), and lease size as class variables. The interaction between class variables was also considered. The GLM model used to estimate grazing costs in Table III-4 excluded size as an explanatory variable because of inadequate sample size at the state level.

¹⁶This is different than the conclusion drawn from the 1966 grazing cost survey. In this earlier study, grazing costs were not statistically higher on USFS compared to BLM.

¹⁷Sheep and cattle were weighted by the proportion of leased AUM's included in the grazing cost survey, 88% cattle and 12% sheep.

BLM Cattle Allotments

Percent of Allotments



USFS Cattle Allotments

Percent of Allotments

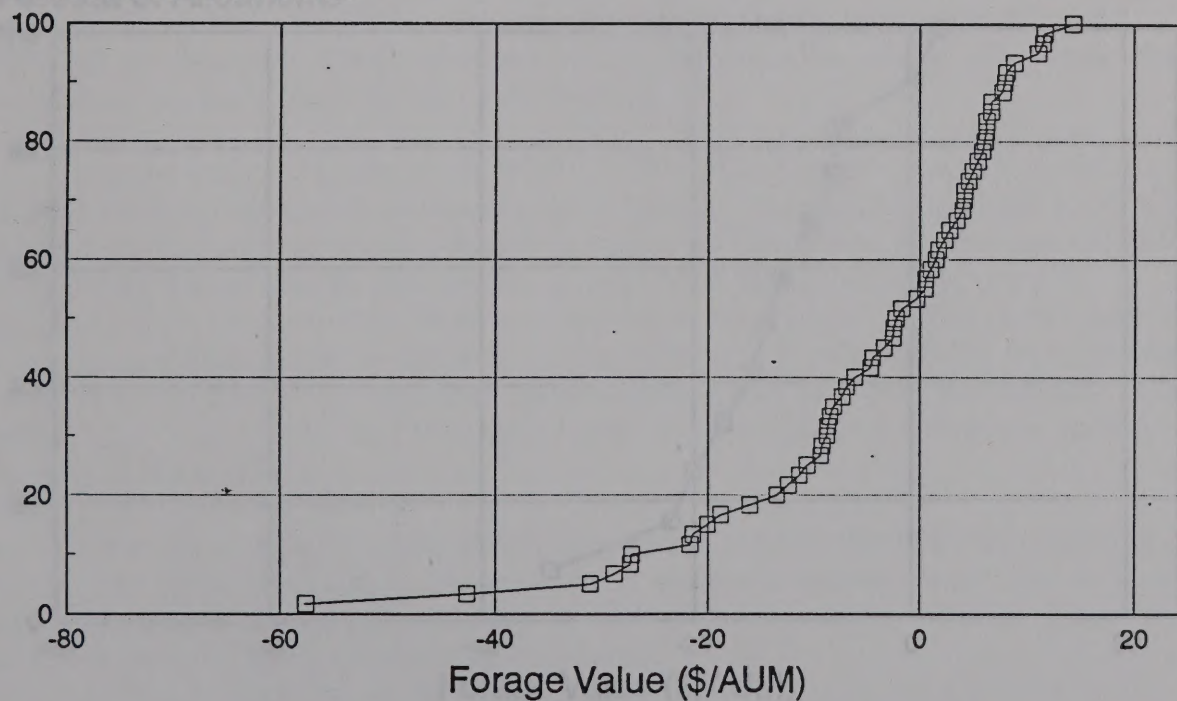
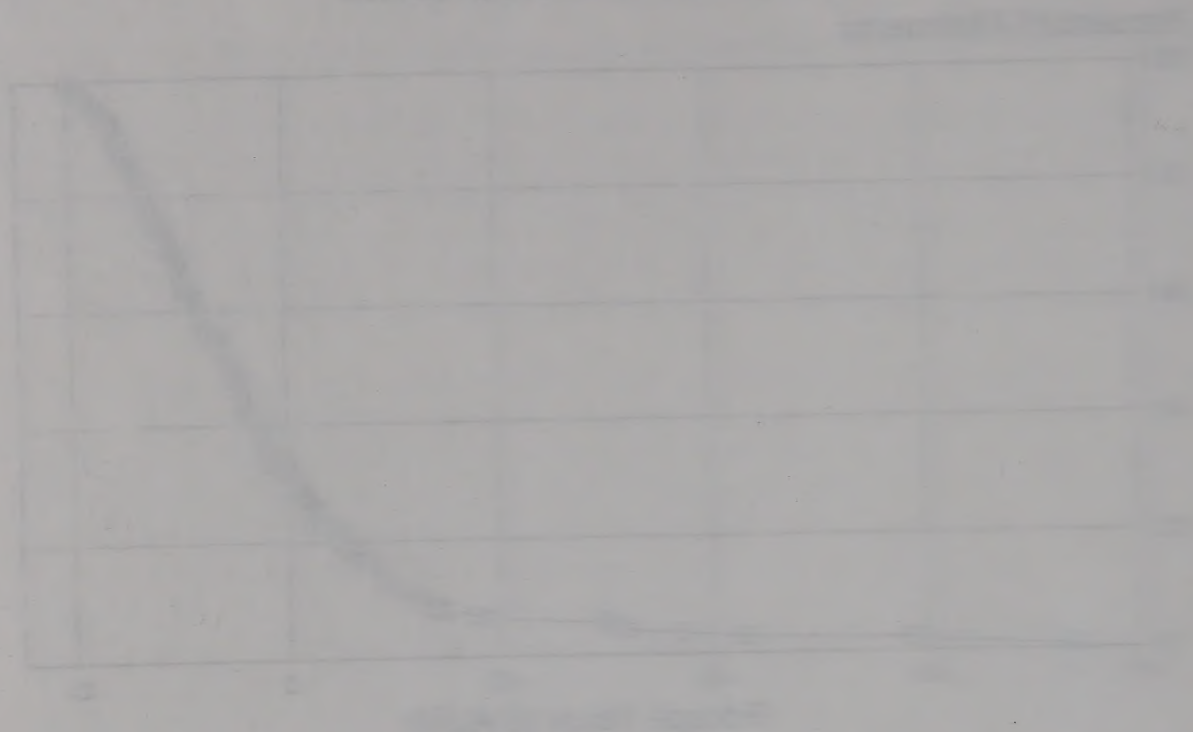


Figure III-2. Cumulative distribution of forage value for cattle allotments in the three state area.

ELM CELL RESPONSE



ELM CELL RESPONSE

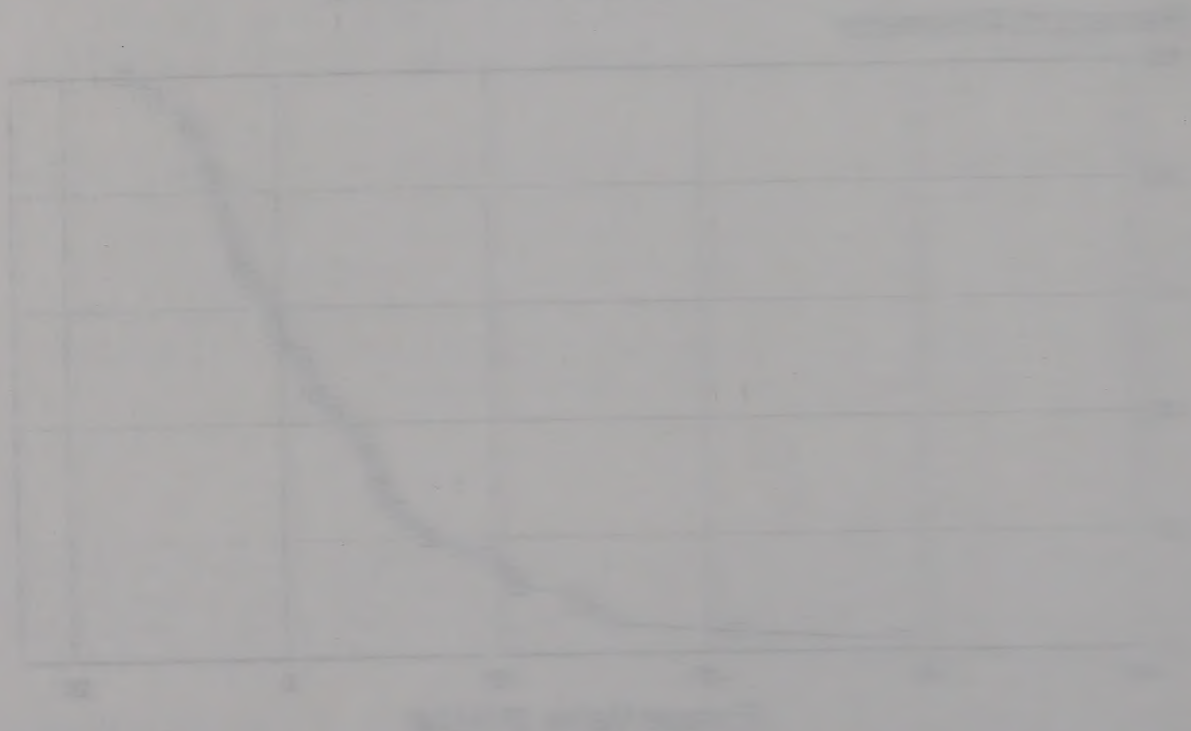
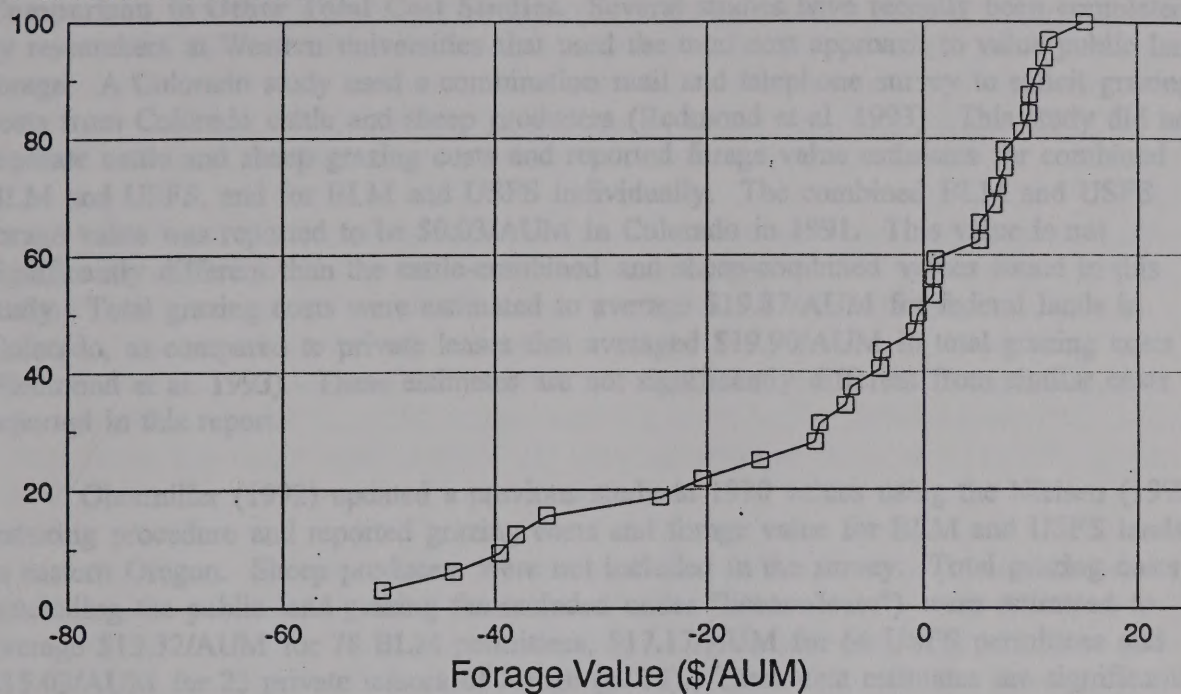


Figure 1. Response of an Elm cell to a step change in input.

BLM Sheep Allotments

Percent of Allotments



USFS Sheep Allotments

Percent of Allotments

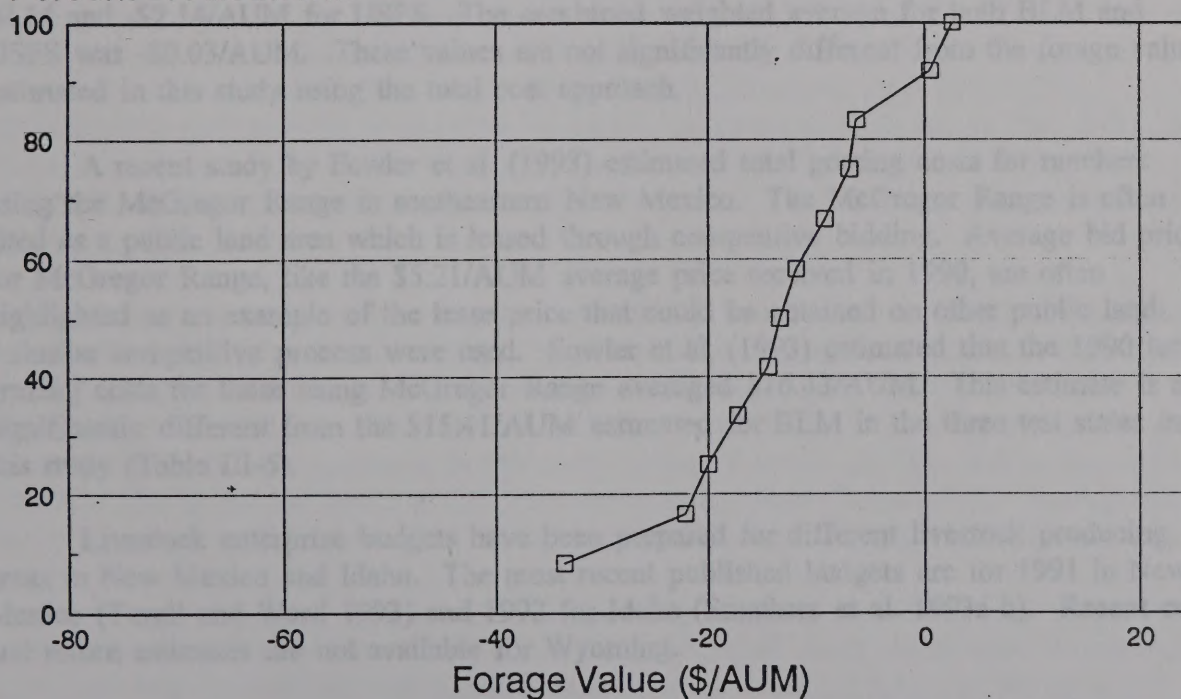


Figure III-3. Cumulative distribution of forage value for sheep allotments in the three state area.

Comparison to Other Total Cost Studies. Several studies have recently been completed by researchers at Western universities that used the total cost approach to value public land forage. A Colorado study used a combination mail and telephone survey to solicit grazing costs from Colorado cattle and sheep producers (Redmond et al. 1993). This study did not separate cattle and sheep grazing costs and reported forage value estimates for combined BLM and USFS, and for BLM and USFS individually. The combined BLM and USFS forage value was reported to be \$0.03/AUM in Colorado in 1991. This value is not significantly different than the cattle-combined and sheep-combined values found in this study. Total grazing costs were estimated to average \$19.87/AUM for federal lands in Colorado, as compared to private leases that averaged \$19.90/AUM in total grazing costs (Redmond et al. 1993). These estimates are not significantly different from similar costs reported in this report.

Obermiller (1992) updated a previous study to 1990 values using the Nielsen (1992) indexing procedure and reported grazing costs and forage value for BLM and USFS lands in eastern Oregon. Sheep producers were not included in the survey. Total grazing costs (excluding the public land grazing fee included under "license/lease") were estimated to average \$13.32/AUM for 78 BLM permittees, \$17.17/AUM for 64 USFS permittees and \$15.03/AUM for 23 private lessors of forage (p. 13). These cost estimates are significantly less than similar estimates reported in this study (Table III-5).

Obermiller (1992) estimated the value of public land forage to be \$1.71/AUM for BLM and -\$2.14/AUM for USFS. The combined weighted average for both BLM and USFS was -\$0.03/AUM. These values are not significantly different from the forage values estimated in this study using the total cost approach.

A recent study by Fowler et al. (1993) estimated total grazing costs for ranchers using the McGregor Range in southeastern New Mexico. The McGregor Range is often cited as a public land area which is leased through competitive bidding. Average bid prices for McGregor Range, like the \$5.21/AUM average price received in 1990, are often highlighted as an example of the lease price that could be obtained on other public lands if a similar competitive process were used. Fowler et al. (1993) estimated that the 1990 total grazing costs for those using McGregor Range averaged \$16.43/AUM. This estimate is not significantly different from the \$15.41/AUM estimated for BLM in the three test states in this study (Table III-5).

Livestock enterprise budgets have been prepared for different livestock producing areas in New Mexico and Idaho. The most recent published budgets are for 1991 in New Mexico (Torell and Word 1993) and 1992 for Idaho (Smathers et al. 1993a-h). Recent cost and return estimates are not available for Wyoming.

State-level livestock budgets present estimates of returns and costs for representative ranches that use alternative management practices and depend to varying degrees on public land for grazing capacity. Data for these enterprise budgets were gathered without specific

objectives related to public land policy. As such, they provide a basis for comparison to the cost data collected here, which very clearly was gathered to evaluate public land grazing fees. Because enterprise budgets estimate total costs, and not just forage harvesting costs as we supposedly estimated in this study, it would be anticipated that costs per AUM in enterprise budgets would be higher than those estimated here.

Torell and Word (1993) estimated total production costs for medium-sized ranches ranged from \$23.20/AUM in northwest New Mexico, where USFS ranches are common, to \$21.60/AUM in southwestern New Mexico, where BLM ranches are common. The medium-size ranch was defined to graze about 270 AUY's (animal units yearlong) or to use about 3,240 AUM's. Grazing costs estimated in this study for the same size category averaged \$12.65/AUM for BLM ranches and \$15.58/AUM for USFS ranches (Table III-5). Thus, forage harvesting costs in this study were estimated to be about 60 to 70% of total ranch production costs.

Small New Mexico ranches were defined to use about 1,350 AUM's (113 AUY). Total production costs for this size ranch were estimated to be about \$30/AUM (Torell and Word 1993). By comparison, forage harvesting costs for this ranch were estimated to be \$15.25/AUM for BLM and \$19.53/AUM for USFS (Table III-5). Forage harvesting costs averaged 50 to 60% of total production costs for this size classification.

Unlike New Mexico enterprise budgets, those defined for Idaho are based on management practices and land base instead of a regional definition. Four Idaho cattle and 4 sheep budgets were defined for the 1992 production year. Total costs estimated for cattle ranged from \$24.84/AUM (500 cow year-round BLM, Smathers et al. (1993b)) to \$34.88/AUM (200 cow BLM and USFS seasonal, Smathers et al. (1993a)). BLM forage harvesting costs estimated here were \$12.55/AUM and USFS costs were \$20.88/AUM (Table III-4). Forage harvesting costs ranged from 35 to 75% of total production costs for all Idaho cattle budgets.

Total sheep production costs were estimated to average about \$21/AUM for large ranches in eastern New Mexico using private and BLM rangeland (Torell and Word 1993). Total sheep production costs in Idaho were much higher, ranging from \$43.60/AUM (Smathers et al. 1993g) to \$58.26/AUM (Smathers et al. 1993e). By comparison, sheep forage harvesting costs estimated in this study, averaged across all three test states, were \$20.46/AUM on private land and \$23.23/AUM on BLM land (Table III-4). Average forage harvesting costs in Idaho were \$32.32/AUM on BLM land and \$28.64/AUM on USFS land.

Forage harvesting costs reported in this study are from 35-75% of total production costs estimated independently. This would be the expected result unless costs reported in this study were inflated because of the highly-publicized grazing fee issue we set out to address. We conclude from this cost comparison, and from our evaluation of the interview process, that ranchers interviewed in this study did not significantly inflate grazing costs.

negative which is highly unlikely. As such, they provide a basis for concluding that the cost data collected here which were obtained as a result of the study are likely to be more accurate than those obtained from the survey data. The survey data were obtained in the early 1970s and it would be expected that costs for wheat in the early 1970s would be higher than those obtained here.

Town and Wood (1977) estimated total production costs for wheat in the early 1970s in the United States. Their estimates were based on data from the 1970-71 survey. Their estimates of total production costs for wheat in the early 1970s were \$1.15 per bushel. This is very close to the \$1.14 per bushel estimated in this study. The survey data were obtained in the early 1970s and it would be expected that costs for wheat in the early 1970s would be higher than those obtained here.

Small New Mexico ranches were defined as those with less than 1,000 acres. Total production costs for this size ranch were estimated to be about \$1.14 per bushel. By comparison, large ranches (over 1,000 acres) were estimated to be \$1.15 per bushel. This is very close to the \$1.14 per bushel estimated in this study. The survey data were obtained in the early 1970s and it would be expected that costs for wheat in the early 1970s would be higher than those obtained here.

Public New Mexico ranches were defined as those owned by the state or local government. Total production costs for this size ranch were estimated to be about \$1.14 per bushel. By comparison, private ranches (not owned by the state or local government) were estimated to be \$1.15 per bushel. This is very close to the \$1.14 per bushel estimated in this study. The survey data were obtained in the early 1970s and it would be expected that costs for wheat in the early 1970s would be higher than those obtained here.

Total wheat production costs were estimated to be about \$1.14 per bushel. This is very close to the \$1.14 per bushel estimated in this study. The survey data were obtained in the early 1970s and it would be expected that costs for wheat in the early 1970s would be higher than those obtained here.

Wheat production costs reported in this study are based on the 1970-71 survey. This would be the expected result when costs reported in the early 1970s are compared to the early 1970s. The survey data were obtained in the early 1970s and it would be expected that costs for wheat in the early 1970s would be higher than those obtained here.

The resulting cost estimates are consistent with independent estimates of cost made when the grazing fee was not the primary issue of investigation.

Indexing the 1966 Forage Valuation Study. The \$1.23 base forage value in the current PRIA formula was derived from the extensive 1966 Western Livestock Grazing Survey that utilized the total cost approach. An examination of the level and percentage of costs from the 1966 study compared to those found in the 1992 study are found in Appendix C, Table C-5. Costs are reported for cattle and sheep on private and public leases. The 1966 study did not report costs separately for BLM and USFS allotments so the comparison is made for combined public lands.

Categorically, most costs had the same directional shift for cattle and sheep on both public and private leases. As a percent of all costs, death loss was higher in the 1992 study while veterinary costs were lower. Salt and supplemental feed also made up a smaller percentage of the costs in the 1992 survey. Costs of moving and herding livestock made up a larger percentage of the 1992 costs while horse use costs and miscellaneous labor and mileage encompassed a smaller percentage of the 1992 costs. One abnormality was that herding costs on private sheep leases decreased as a percentage of total costs in the 1992 survey, perhaps because of increased use of fencing and less reliance on hired sheep herders on private land.

The percentage of costs allocated to water services decreased from the 1966 study for all leases. Development depreciation made up a smaller percentage of 1992 total costs on public lands but a slightly larger percentage of 1992 costs on private leases, while improvement maintenance costs encompassed a larger percentage of the 1992 costs. Many of the ranchers interviewed stated that the majority of developments on public lands were made prior to the 1971 date used in this study. The changes in the percentage of total costs tends to substantiate this, with ranchers investing more in the maintenance of range improvements.

To examine the validity of updating costs from the 1966 Western Livestock Grazing Survey, the costs obtained in the 1966 study were indexed using three procedures. The first two procedures followed steps outlined in the 1992 grazing fee update (USDA/USDI 1992, pp. 57-58). The first procedure updated 1966 costs with the Input Cost Index (ICI) to 1992 values. The second procedure updated the 1966 costs to 1990, 1991 and 1992 values, with an average taken of the three years to smooth out fluctuations. The third procedure followed the approach of Nielsen (1992a) and utilized various agricultural production indices reported by USDA-NASS (1992a) to update costs to 1992.

Indexing of individual cost categories is shown in Appendix C (Tables C-10 to C-12), while the summaries and comparison to our current study are presented in Table III-6. Updating to 1992 using the ICI resulted in a combined cattle and sheep forage value of \$3.34/AUM. The weighted average from the ICI 1990-92 index was \$3.15/AUM for 1990-1992. The weighted average for cattle and sheep in this study was much lower

Table III-6. Comparison of total grazing costs per AUM, private lease rates and forage value with 1966 values indexed to current levels using various indexing procedures.

		1992 Total Non-fee Costs				Private Lease Rate				Forage Value			
		1992 Cost Survey	1992 ICI Indexed	1990-92 ICI Indexed	Various Cost Indices	1992 Cost Survey	1992 ICI Indexed	1990-92 ICI Indexed	Various Cost Indices	1992 Cost Survey	1992 ICI Indexed	1990-92 ICI Indexed	Various Cost Indices
C a t t l e	Private	11.33 ± 1.42	7.98	7.95	11.32	7.71 ± 0.56	4.92	4.73	4.74				
	BLM	15.41 ± 1.62								3.63 ± 2.42			
	USFS	21.89 ± 2.11								-2.86 ± 2.59			
	BLM/ USFS	18.15 ± 1.33	9.51	9.48	13.25					0.89 ± 2.06	3.39	3.20	2.81
S h e e p	Private	13.28 ± 4.98	11.28	11.24	16.63	7.18 ± 1.87	4.87	4.67	4.69				
	BLM	23.23 ± 3.72								-2.77 ± 6.22			
	USFS	32.68 ± 5.34								-12.22 ± 6.94			
	BLM/ USFS	25.87 ± 2.97	13.14	13.09	19.18					-5.41 ± 5.87	3.01	2.82	2.14
B o t h	BLM									2.85			
	USFS									-3.98			
	BLM/ USFS									0.13	3.34	3.15	2.73

Note: Total grazing costs for private leases, as reported in earlier tables, are the sum of total non-fee costs and the private lease rate reported in this table. Totals are separated here to show where differences occur. Forage value is defined to be private non-fee costs plus the private lease rate minus the non-fee costs estimated for public land. The ICI indexing procedure used by USDA/USDI (1992) indexed private lease rates using the 16 western state forage value index (FVI). The indexing by Nielsen, using various cost indices, used the 11 western state forage value index. Forage value for "both" cattle and sheep combined was estimated by weighting individual estimates by the proportion of cattle and sheep AUMs included in the grazing cost survey, 88% cattle and 12% sheep.

(\$0.13/AUM, Table III-6).

The 1966 study did not report separate forage values for BLM and USFS forage. However, we can compare 1992 values for BLM and USFS with the average values from 1966 indexed to 1992. The BLM weighted average forage value for cattle and sheep in this study was \$2.85/AUM. This was slightly, but not significantly, higher than the ICI indexed values (Table III-6). The average cattle and sheep forage value for USFS was -\$3.98/AUM, which was significantly lower than indexed 1966 values. Analysis showed that neither the forage value for cattle nor sheep on BLM were significantly different than the \$3.34/AUM or \$3.15/AUM obtained from indexing using the ICI. However, both the forage values for USFS were significantly lower than the ICI indexed values.

The third indexing procedure followed Nielsen (1992a) and used various agricultural production indices reported by USDA-NASS (1992a). This procedure resulted in a combined forage value of \$2.73/AUM that was slightly lower than the value obtained using ICI. Again, this value was not significantly different than the combined BLM/USFS forage values found in this study. The USFS values in this study were significantly lower than Nielsen's indexed value while BLM values were not significantly different.

The values obtained from the total cost approach used in the current study and those obtained in the 1966 study are the result of the differences between total non-fee costs on federal land and the non-lease costs plus the lease rate on private lands. Although the forage values determined in this study were not significantly different than those values determined by indexing 1966 values, except for USFS forage, an examination of differences between non-fee/lease costs and private lease rates shows significant differences. The private lease rates of \$7.71/AUM for cattle and \$7.18/AUM for sheep were significantly higher than indexed 1966 lease rates, which ranged from \$4.67 to \$4.92/AUM depending on the indexing procedure used (Table III-6). This difference results because the \$1.79/AUM lease rate used in the 1966 calculation was adjusted downward to reflect a "non-serviced" (excluding service value) lease price. The average NASS reported lease rate over the 1964-68 base period was \$3.65/AUM (USDA/USDI 1986, p. 17).

We are unclear why the lease rate was adjusted downward in the 1966 grazing fee study. Similar to the data gathered in this study, non-fee costs included private leases ranging from no services provided to all services provided. If the lessor provided services as a condition of the lease, it would be expected that the lease price would be higher. The average lease rate was the average for all individuals included in the cost survey, and it is our belief that this average value should have been used.

Non-fee cost estimates determined in this study were consistently higher than non-fee costs indexed with the ICI procedure. The non-fee costs ranged from \$3 to \$12 higher than the ICI indexed non-fee costs (Table III-6). Non-lease costs using ICI were significantly less for cattle compared to the 1992 costs, but were not significantly different for private sheep production. Forage values were not different for combined BLM and

USFS because although both non-fee costs and private lease rates were underestimated when indexing 1966 amounts to 1992, the differences between federal and private grazing costs (forage value) remained relatively constant. There was also a major amount of variation in grazing costs with a wide confidence interval estimated.

The 1966 values indexed to 1992 using Nielsen's procedure resulted in higher non-fee costs. The non-fee costs using Nielsen's indexing were still significantly lower for cattle on combined BLM and USFS. Again, forage values calculated from differences between private and public costs canceled out these differences when estimating forage values.

Permit Value Approach

Table III-7 shows estimated permit values for Idaho, New Mexico and Wyoming and the 1992 forage value implied from these values. Average permit values ranged from \$35/AUM for BLM in Wyoming to \$89/AUM for BLM in New Mexico. BLM and USFS permit values were significantly different in Wyoming but not in Idaho or New Mexico. Statistical differences between states were not evaluated because different procedures were used to estimate permit value in New Mexico as opposed to Idaho and Wyoming.

Permit value is the estimated average market value of federal grazing permits, including the value of range improvements on federal land. Average rancher-funded range improvements on federal land since 1971 (Table III-2) amounted to less than 10% of the estimated 1992 permit value in each state. Other functional range improvements constructed prior to 1971 also contributed to the value of grazing permits.

Table III-7. Grazing permit value and forage value implied from average permit values in Idaho, New Mexico and Wyoming (\$/AUM), 1992.

State	Permit Value		Forage Value ¹	
	BLM	USFS	BLM	USFS
Idaho	37 ^a (1.31, 129)	42 ^a (2.71, 38)	3.16	3.32
New Mexico	89 ^a	72 ^a	4.90	4.33
Wyoming	36 ^a (1.01, 359)	47 ^b (3.47, 43)	3.13	3.50

Note: Means in the same row that are followed by the same letter are not statistically different at the $\alpha = 0.10$ level. Means in the same column are compared statistically. The numbers in parenthesis are the standard error of the mean and the sample size. The standard error is not shown for New Mexico because the mean value is estimated from a regression model.

¹/Estimated as permit value \times 3.35% + \$1.92/AUM 1992 grazing fee.

Because permit value was estimated to be highest for the yearlong permits common in New Mexico, the implied forage value using the permit valuation method was highest in New Mexico (\$4.90/AUM for BLM and \$4.33/AUM for USFS). Forage value was estimated to be about \$3.00 to 3.50/AUM for the seasonal permits found in Idaho and Wyoming.

Theoretically, grazing fees equal to the forage value estimates in Table III-7 should eliminate permit value. Yet, permit value estimates in New Mexico for state trust lands indicate this may not be the case. Torell and Doll (1991) estimated that as New Mexico state land grazing fees went from \$1.60/AUM in 1986 to \$3.13/AUM in 1989 the value of state land grazing permits decreased by about \$30/AUM for every \$1/AUM increase in the fee. State land permits went from the most valuable permit to the least valuable permit in 6 years. New regression estimates conducted for this study indicate that New Mexico state land permits have recently increased in value relative to BLM and USFS. This is true even though New Mexico state land fees are nearly double those on federal lands and USFS total grazing costs were estimated to be considerably higher than those on BLM land (Table III-5 and Appendix C).

Market Rental Approach

Appraisal Approach. BLM appraisers searched the three-state market for comparable leases of public forage. They located and documented leases of public forage based on competitively bid or negotiated rental structures. To this end, federal, state, county, and tribal leases were investigated as well as "subleases" of BLM allotments and state lands. To maximize comparability with public lands, non-serviced leases were sought. Given that 100% non-serviced leases were difficult to find, nominally serviced leases were included in the data search. These leases were then adjusted to a non-serviced basis utilizing cost figures obtained from regression equations detailed in the next section.

No comparable lease data were obtained in Idaho. However, suitable data were located and researched in New Mexico and Wyoming. In Wyoming, the Bureau of Indian Affairs, the Bureau of Reclamation, the U.S. Fish and Wildlife Service (USFWS), the Wyoming State Land Office (WYSLO), and the Wyoming Game and Fish Department were queried. The Bureau of Indian Affairs stated that forage leases on the Wind River Reservation were administratively set at \$0.60/AUM for tribal members. The USFWS stated that they did not lease any forage within the state. The Wyoming Game and Fish Department said that they had only a few leases for forage and provided three for this study. The Bureau of Reclamation leased some of their forage on a competitive basis and provided fourteen leases for this study. The Bureau lease documents were then personally verified with the Cody and Casper offices. Most of the leases had no lessor-provided services. In some cases, fencing materials and weed control were furnished by the government; however, the appraiser's research indicated that the value of these supplies and services was historically low. From the Wyoming Game and Fish Department and Bureau of Reclamation leases, twelve comparable leases were adjusted to a net basis. After

Table III-8. Market rental values in New Mexico and Wyoming as determined using an appraisal valuation, 1992.

State	Sample size (n)	Total Number of AUM's	\$/AUM		
			Average Lease Price	Adjustment for Services	Average net forage value
<u>New Mexico</u>					
1. Comparable Leases	8	12,854	6.22 (12.64)	1.58	4.64 (11.83)
2. McGregor Range Leases	12	26,579	4.80 (9.99)	1.96	2.84 (9.99)
Average	20	39,433	5.26 (10.21)	1.86	3.40 (11.49)
<u>Wyoming</u>					
1. Fish and Game\ Bureau of Reclamation	12	1,412	7.71 (4.97)	0.15	7.56 (4.67)
2. State subleases	11	4,017	7.93 (10.03)	0.87	7.06 (9.45)
Average	23	5,429	7.88 (5.33)	0.69	7.19 (5.06)

Note: The numbers in parenthesis are the standard error of the mean.

minimal adjustments, the AUM-weighted average was \$7.56/AUM (Table III-8), ranging from \$5.00 to \$9.80 per AUM (Appendix C, Table C-13).

Subleasing of Wyoming State lands is legal and approximately 300 subleases exist. A random sample of 20 leases were provided for this study. It is the practice of the WYSLO to collect 50% of the excess rent realized by the sublessor. To this end, gross lease payments are adjusted for the value of the sublessor's improvements (if any). The residual amount represents the WYSLO estimate of net forage value. This figure is then divided by the total number of AUM's in the lease to derive a net-value-per-AUM. The net forage value per AUM is then applied to the AUM count in the State lease. The BLM appraisers accepted the validity of this analysis and concluded that eleven of these subleases were sufficiently comparable to include in this study. The resulting subleases ranged from \$4.56 to \$10.54 per AUM with the AUM-weighted average was \$7.06 per AUM (Appendix C, Table C-14).

The New Mexico survey yielded 11 suitable BLM subleases, the 1992-1993 bid results for the McGregor Range, several New Mexico State Land Office (NMSLO) leases (competitively bid), one small USFWS lease on a wildlife refuge, and a large ranch recently

purchased by the Acoma Tribe and leased on a nonserviced basis. Further analysis of this data indicated that only the McGregor Range data and eight of the eleven BLM subleases were suitable for further analysis and comparison with the total cost approach.

Adjustments to the sublessor's proceeds were generally limited to fence and water maintenance materials on the BLM subleases. Because actual costs for these adjustments were unavailable, average values for fence and water materials from the grazing cost survey were used. After acknowledging these adjustments, the AUM-weighted average value of forage was \$4.64/AUM (Table III-8), ranging from \$3.45/AUM to \$5.59/AUM (Appendix C, Table C-15).

The McGregor Range data were also adjusted for lessor-provided (BLM) services. Because BLM investments on the McGregor Range exceed that which would be normal in the market, typical costs were obtained from regression equations described below. The gross rental rates for the McGregor Range varied from \$4.00 to \$7.65 per AUM, with an AUM-weighted average of \$4.80/AUM. Because lessor-provided services were estimated to be worth \$1.96/AUM, the 1992 net value of forage was considered to be \$2.84/AUM. Many of those leasing the McGregor Range transport cattle long distances to the missile range, the water systems in some pastures are in poor condition and there is a "military nuisance" with which to contend. On the plus side, the McGregor Range is not managed for multiple-use and the missile range is not open to the general public without an access permit. Thus, it lacks the multiple-use conflict associated with most BLM and USFS lands. Lease rates on the missile range are closely related to rainfall and range conditions in New Mexico and west Texas. Dry years like 1984 caused a much stronger demand for McGregor Range forage as southwest ranchers searched for alternative forage sources (Gallacher 1992). The implied forage value from annual McGregor Range leases varies considerably as market conditions change.

As with most forage evaluation techniques, the market appraisal approach has not been without its critics. Kearl (1989) summarized some of the concerns with this approach. These concerns include:

1. The land leasing market exhibits more characteristics of a monopolistic competition with price discrimination as an option than that of a purely competitive market, thus questioning the ability to find leases that are "competitively bid or negotiated".
2. There are comparatively few useable lease observations for most areas, especially non-service leases.
3. There is generally no indication of the dependency of lessees on the leased land. For example, some ranchers are willing to pay excessive lease rates in times of drought to maintain the genetic infrastructure of their cow herd. Leases may also make up a small proportion of the total AUM's utilized by the ranch.

Statistical Approach. To complement the market rental comparison, the private leases utilized in the 1992 grazing cost survey were further examined to see if the value of services provided by the lessor could be statistically estimated and subtracted from the private land lease rate to estimate net forage value. These data presented a unique opportunity to evaluate which factors influence grazing lease rates and grazing costs on private lands.

Private grazing lease arrangements were characterized based upon questions asked in the grazing cost survey (pages 2 and 3, Appendix D, private lease survey). This information was combined with the grazing cost calculations detailed earlier in this document.

Summary statistics for private leases contained in the 1992 grazing cost survey are shown in Table III-9. A relatively large range exists in the price paid per AUM for private leases. The most expensive lease was \$21.11 per AUM in Idaho, and the least expensive was \$0.75 per AUM in New Mexico. When compared to the average non-serviced rates reported in the market appraisal approach, the range of lease rates obtained from the grazing cost survey were greater and the mean price of the leases tended to be higher, especially in New Mexico. This would be expected because the appraisal comparison was limited to leases that were mostly public lands and had few lessor services provided. By comparison, no attempt was made to limit the leases included in the statistical comparison. The regression analysis included private leases ranging from all services provided to no services provided.

The distribution of the lease rate for the leases obtained from the interviews is further examined in Figure III-4. While the ranges were chosen arbitrarily, the majority of

Table III-9. Average private lease rates and size of leases for the three-state test area for cattle operations.

State	Number of Leases	Mean (\$/AUM)	Minimum (\$/AUM)	Maximum (\$/AUM)	Standard Error
Idaho					
Lease rate	46	8.70	2.33	21.11	0.67
AUM's		596	30	5,102	
New Mexico					
Lease rate	44	6.88	0.75	15.39	0.30
AUM's		2,997	120	43,937	
Wyoming					
Lease rate	44	7.71	1.87	13.26	0.52
AUM's		924	33	4,866	

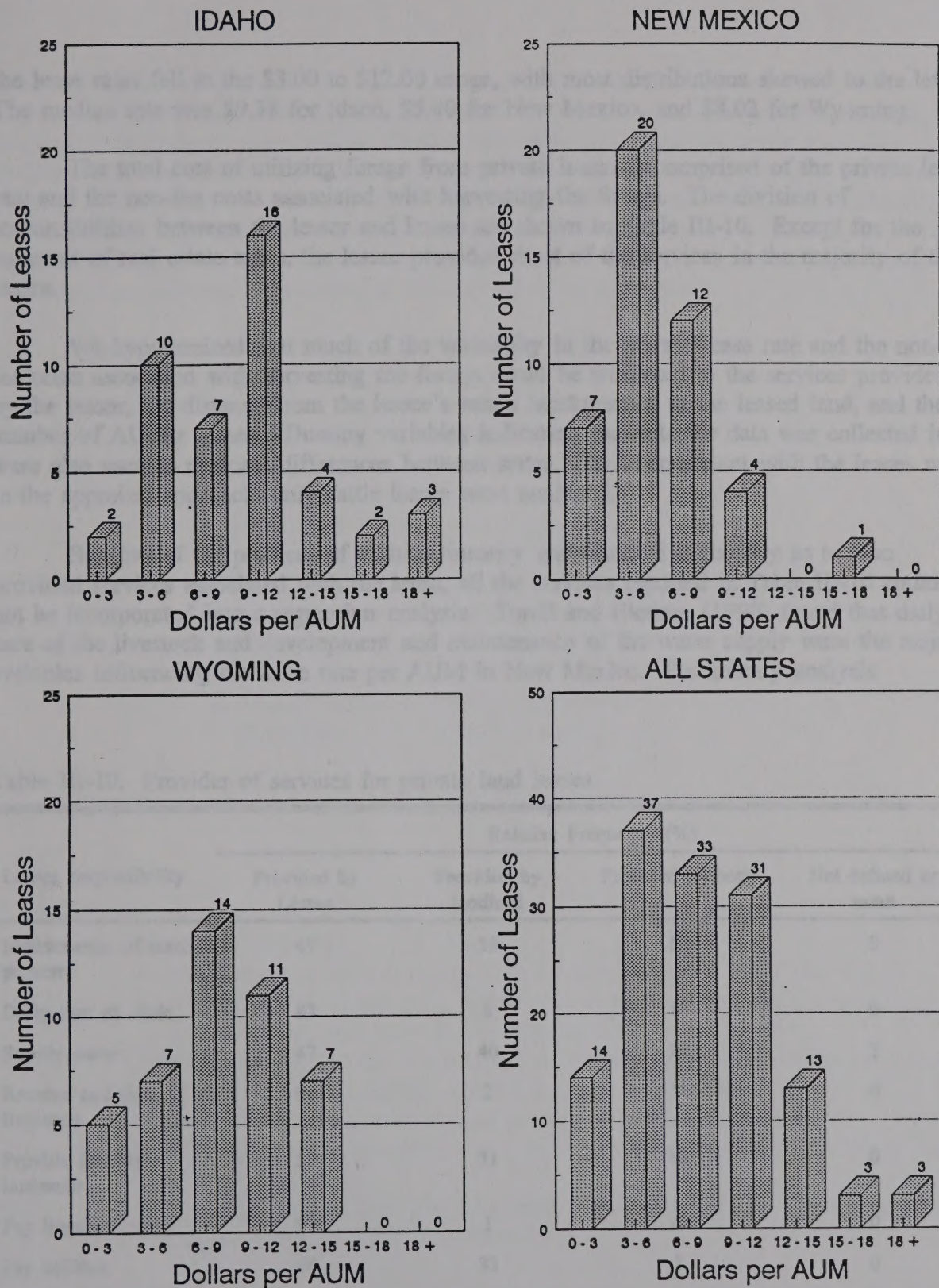


Figure III-4. Distribution of private rangeland lease rates in Idaho, New Mexico, Wyoming and All States combined.

the lease rates fell in the \$3.00 to \$12.00 range, with most distributions skewed to the left. The median rate was \$9.38 for Idaho, \$5.40 for New Mexico, and \$8.02 for Wyoming.

The total cost of utilizing forage from private leases is comprised of the private lease rate and the non-fee costs associated with harvesting the forage. The division of responsibilities between the lessor and lessee are shown in Table III-10. Except for the payment of real estate taxes, the lessee provided most of the services in the majority of the leases.

We hypothesized that much of the variability in the private lease rate and the non-fee costs associated with harvesting the forage could be attributed to the services provided by the lessor, the distance from the lessee's ranch headquarters to the leased land, and the number of AUM's leased. Dummy variables indicating the state the data was collected in were also used to evaluate differences between states. To be consistent with the leases used in the appraisal approach, only cattle leases were analyzed.

Because of the problem of multicollinearity and minimal variability as to who provided services associated with the lease, all the services reported in Table III-10 could not be incorporated into a regression analysis. Torell and Bledsoe (1990) found that daily care of the livestock and development and maintenance of the water supply were the major variables influencing the lease rate per AUM in New Mexico. Preliminary analysis

Table III-10. Provider of services for private land leases.

Lessee responsibility	Relative Frequency (%)			
	Provided by Lessee	Provided by landlord	Provided by both	Not defined or none
Maintenance of ranch property	49	36	15	0
Daily care of cattle	83	8	9	0
Supply water	47	40	13	2
Receive and ship livestock	91	2	7	0
Provide liability insurance	59	31	10	0
Pay livestock taxes	99	1	0	0
Pay utilities	66	33	1	0
Absorbs death losses	61	1	5	33
Real estate taxes	9	90	1	0

indicated the same results for the three-state test area. Daily livestock care and water supply were therefore the only two service variables included in the regression analysis. Regression techniques were used to identify how lease prices and the lessee's non-fee grazing costs varied as services were or were not provided by the lessor. This provided an estimate of the value of services provided by the lessor and the net forage value of a non-serviced lease. The hypothesis was that as services were provided by the lessor, the lease rate would increase but the lessee's non-fee grazing costs would be reduced by an equal amount. The estimated parameters of the regression models were:

$$\begin{aligned}
 [1] \quad \text{NONFEEC} = & 11.19 + 0.053 \text{ DIST} - 6.16 \text{ CARE} - 2.67 \text{ WATER} \\
 & (1.55)^* (0.026)^* (2.74)^* (1.74) \\
 & - 0.0003 \text{ AUM} + 2.07 \text{ ID} + 6.12 \text{ NM} \\
 & (0.0002) (1.75) (1.82)^* \\
 R^2 = & .17, F = 4.44, n = 134
 \end{aligned}$$

$$\begin{aligned}
 [2] \quad \text{PLR} = & 6.72 - 0.009 \text{ DIST} + 2.42 \text{ CARE} + 1.96 \text{ WATER} \\
 & (0.66)^* (0.011) (1.17)^* (0.74)^* \\
 & - 0.00007 \text{ AUM} + 1.42 \text{ ID} - 1.95 \text{ NM} \\
 & (0.00008) (0.74)^* (0.78)^* \\
 R^2 = & .27, F = 7.61, n = 134
 \end{aligned}$$

where,

NONFEEC	=	non-fee costs associated with the use of private leases
PLR	=	private lease rate
DIST	=	the distance (miles) from the lessee ranch headquarters to the lease
CARE	=	responsibility for the daily care of the livestock (0=lessee, 0.5=joint responsibility, and 1.0 = lessor responsibility)
WATER	=	responsibility for the maintenance of the livestock water supply (0=lessee, 0.5 = joint responsibility, and 1.0 = lessor responsibility)
AUM	=	Number of animal unit months of grazing provided by the lease
ID	=	Dummy variable indicating the lease was located in Idaho (1 = Idaho lease, 0 = not Idaho)
NM	=	Dummy variable indicating the lease was located in New Mexico (1 = New Mexico lease, 0 = not New Mexico)

Standard errors are in parenthesis beneath each parameter estimate, with asterisks indicating that the parameter estimate was significantly different from zero at the 0.10 level or higher. The equations explained a significant amount of the variation in grazing costs

and lease rates but the relatively low R^2 values indicate a large part of the variation in grazing costs and lease rates was not accounted for.

Average non-fee grazing costs (excluding the private lease fee) indicated from the regression results are shown in Table III-11 for each of the three states. Results indicated that average non-fee grazing costs were \$11.19/AUM in Wyoming, \$13.26/AUM (\$11.19 + \$2.07) in Idaho and \$17.31 (\$11.19 + \$6.12) in New Mexico. Non-fee costs were not significantly different between Idaho and Wyoming, but New Mexico was significantly higher.

After adjusting for the average size and distance of leases, the average non-fee grazing costs incurred when no lessor services were provided was \$14.96/AUM for Idaho, \$17.71/AUM for New Mexico and \$12.50/AUM for Wyoming (Table III-11). The lessee's non-fee grazing costs were significantly less when the lessor provided care of livestock as part of the lease agreement; non-fee costs decreased by an average of \$6.16/AUM when care of livestock was provided. When the lessor provided water to livestock on a daily basis the lessee's non-fee costs were reduced by \$2.67/AUM, but this estimate was not significantly different from zero at the 0.10 significance level (t-statistic of -1.53).¹⁸

When no livestock care or water maintenance was provided, the average private lease rate per AUM was \$6.93 in Wyoming, \$8.42 in Idaho and \$4.79 in New Mexico (Table III-12). If the lessor provided the daily livestock care, the private lease rate went up by \$2.42/AUM. When the lessor maintained the water supply, the lease rate increased by \$1.96/AUM. There was no significant discount to the lessee if the lease was not conveniently located to the ranch headquarters. There also appeared to be no significant relationship between the size of the lease in AUM's and the lease price.

Table III-11. Average private lessee grazing costs (excluding the private lease fee) in Idaho, New Mexico and Wyoming when lessor services were and were not provided, 1992.

State	Intercept	Adjust- ment for Average Distance	Adjust- ment for Average Size	Ave.Cost No Lessor Services	Care of Cattle Provided	Water Provided	Ave.Cost With Lessor Services
Idaho	13.26	1.86	-0.16	14.96	-6.16	-2.67	6.13
New Mexico	17.31	1.22	-0.82	17.71	-6.16	-2.67	8.88
Wyoming	11.19	1.59	-0.28	12.50	-6.16	-2.67	3.67

Note: Average distance from the ranch (weighted by number of AUM's on the grazing parcel) was 35 miles for Idaho, 23 miles for New Mexico, and 30 miles for Wyoming. Average size of lease was 543 AUM's for Idaho, 2,749 AUM's for New Mexico and 924 AUM's for Wyoming.

¹⁸ Additional regressions which included slope shifters between states indicated that the adjustments for services provided were not statistically different between states.

Table III-12. Average private lease rate in Idaho, New Mexico and Wyoming when lessor services were and were not provided, 1992.

State	Intercept	Adjust- ment for Average Distance	Adjust- ment for Average Size	No Lessor Services	Care of Cattle Provided	Water Provided	With Lessor Services
Idaho	8.14	0.32	-0.04	8.42	2.42	1.96	12.80
New Mexico	4.77	0.21	-0.19	4.79	2.42	1.96	9.17
Wyoming	6.72	0.27	-0.06	6.93	2.42	1.96	11.31

Note: Average distance from the ranch (weighted by number of AUM's on the grazing parcel) was 35 miles for Idaho, 23 miles for New Mexico, and 30 miles for Wyoming. Average size of lease was 543 AUM's for Idaho, 2,749 AUM's for New Mexico and 924 AUM's for Wyoming.

It is interesting to note what the two regressions say about the average value paid and received by lessee's and lessor's for the major services provided by the lessor. The first equation estimates how the lessee's non-fee grazing costs decrease as lessor services are added. The second equation estimates how payments to the lessor vary when the lessor provides services with the lease. Parameter estimates for care of cattle (CARE) and providing water (WATER) indicate that on average lessees pay less than the value of the services received. Lessee grazing costs are estimated to decrease by an average of \$6.16/AUM when the lessor tends to the livestock on a daily basis (Table III-11). The average payment to the lessor for this service was only \$2.42/AUM (Table III-12); thus, lessee's grazing costs decreased by over twice what it cost for the service. The disparity between reduced lessee costs and payments to the lessor is not as large for providing water. The lessor received an average payment of \$1.96/AUM for providing water, whereas the average reduction in lessee non-fee grazing costs was \$2.67/AUM. The disparity in values might be expected. Because the lessor generally lives at or near the lease, it is likely that in many instances the lessor could provide some services, especially checking of animals, cheaper than the lessee could because of the location advantage.

Comparison to Other Market Statistical Studies. Rimbey et al. (1992) and Torell and Bledsoe (1990) have also used regression techniques to separate observed lease rates into value of forage and value of services components. These earlier studies developed regression equations similar to equation (2) to estimate net forage value. Rimbey et al. (1992) found that when the lessor maintained range improvements or provided liability insurance, private land lease rates were increased by \$2.70/AUM. An adjustment for prepayment of the lease was also made. The 1990 net forage value was estimated to be \$3.81/AUM which was 56% of the private lease rate. This value is significantly different from the \$8.42/AUM value estimated for Idaho during 1992 using a similar valuation approach (Table III-12). It is not significantly different from the \$4.55/AUM value estimated for BLM land in Idaho using the total cost approach (Table III-4).

Torell and Bledsoe (1990) found care of cattle and providing water to be significantly important determinants of lease price. Regional differences in private lease rates within New Mexico were also noted. As a statewide average, when the lessor provided daily care of cattle private lease rates were estimated to increase by \$5.69/AUM. Providing water added another \$1.46/AUM to the lease price. By comparison, equation (2) indicates care of cattle adds \$2.42/AUM and providing water adds \$1.96/AUM.

Torell and Bledsoe (1990) estimated net 1989 forage value, excluding the value of lessor services, averaged \$4.37/AUM in New Mexico. The average 1989 private lease rate was \$5.47/AUM. Updates of these values to 1990 were \$4.78/AUM as a private lease rate and \$3.82/AUM as a net forage value (Torell and Fowler 1992). These estimates of forage value are not significantly different from the \$4.38/AUM estimated for New Mexico during 1992 using the statistical market approach (Table III-12). They are also not significantly different from the \$3.52/AUM value estimated for BLM land in New Mexico using the total cost approach (Table III-4).

Comparison to NASS Private Lease Rates. Private lease rates reported by NASS are frequently compared to the PRIA formula rate. However, there have been concerns about the validity of NASS state-level private lease rates (Torell et al. 1989, Rimbey et al. 1992). The 1992 private land lease rate reported by NASS was \$9.41/AUM for the eleven Western states for cattle (USDA-NASS 1992b). The three state average private land lease rate determined in this study was \$7.76/AUM for cattle which is significantly lower than \$9.41. However in this study, the private land lease rates for cattle were \$8.70, \$6.88, and \$7.71 in Idaho, New Mexico and Wyoming, respectively (Appendix C). NASS reported \$9.49 for Idaho, \$6.95 for New Mexico, and \$9.93 for Wyoming. The NASS lease rates for 1992 are not significantly different from those found for Idaho and New Mexico in this study, but they were significantly higher than those found in Wyoming.

Pricing Areas

1986 Pricing Regions. The 1986 BLM and USFS grazing fee study (USDA/USDI 1986) defined six pricing regions based on observed differences in private land lease rates (Figure II-4). The apparent market value of public land forage was estimated for each of these regions (p. 15), and a variable grazing fee was recommended. The grazing fee report was updated in 1992 and similar appraised values were reported for the six pricing regions. Forage value was estimated to range from \$4.68/AUM in region 5 to \$10.26/AUM in region 1 (USDA/USDI 1992, p. 16). The appraised value for sheep grazing was estimated to be \$0.95/head or \$4.75/AUM for all regions.

Table III-13 shows the 1992 BLM and USFS appraised values compared with forage value estimated here using the total cost approach to valuation. Only regions 3, 4 and 5 are shown because other pricing regions either did not lie in one of the three test states or there was an inadequate sample size. It can be seen that the BLM/USFS appraised value of

Table III-13. Comparison of costs per AUM of grazing cattle¹ on private and public land by pricing areas defined in the 1986 BLM and USFS grazing fee study, 1992.

Pricing Area	Appraised Value ²	Private	BLM	BLM Forage Value	USFS	USFS Forage Value
3	7.74	18.23 ^a (1.08,57)	14.54 ^a (1.13,75)	3.69 ^a ± 2.66 (1.60)	20.46 ^a (1.44,40)	-2.23 ^a ± 2.93 (1.77)
4	6.39	17.42 ^a (1.71,49)	13.51 ^a (1.16,48)	3.91 ^a ± 3.44 (2.07)	21.85 ^a (2.76,14)	-4.43 ^a ± 5.89 (3.53)
5	4.68	18.56 ^a (1.10,12)	15.13 ^a (2.08,15)	3.43 ^a ± 4.30 (2.53)	24.61 ^b (1.89,6)	-6.05 ^a ± 3.53 (2.04)

Note: Means in the same column that are followed by the same letter are not statistically different at the $\alpha = 0.10$ level. Means in the same row are not compared statistically. The numbers in parenthesis are the standard error of the mean and the sample size. Forage value is shown as the mean value with 90% confidence limits about the mean.

¹/Insufficient data to estimate costs per AUM for sheep.

²/The January 1992 appraised market value of grazing mature cattle and horses (over 18 months) on public lands as reported by USDA/USDI (1992, p. 16).

forage is considerably higher than that estimated using the total cost valuation. BLM and USFS were criticized because their 1986 and 1992 appraisal of forage did not consider the costs or value of public lands; only private land leases were evaluated. The major difference in the values is that the total cost valuation considers non-fee grazing cost differences, and it would be expected that forage value estimates using this approach would be less.

Forage value for cattle grazing BLM land was estimated to average \$3.69/AUM in pricing region 3, \$3.91/AUM in region 4 and \$3.43/AUM in region 5 (Table III-13). Forage value for cattle on USFS permits was estimated to be negative for all regions because total grazing costs on USFS were higher than similar costs for private land producers. There was no statistical difference in forage values for BLM or USFS between any of the three pricing regions.

Eco-Physiographic Regions. Table III-14 presents grazing costs and forage value after breaking the cost data into the eco-physiographic regions defined in Figure II-3. As shown, a wide range in average forage values is implied for the various eco-physiographic regions, but only one region, the Middle Rocky Mountains, was significantly different for BLM lands and none were significantly different for USFS. Similar to the findings of Houseman et al. (1968), differences in grazing costs and forage values between regions were not large enough in relation to the wide variation that existed within regions or ranching areas to find statistical differences between regions.

Sample size was limiting for estimating differences in value between eco-physiographic regions. Splitting the data into so many regions resulted in a limited sample size for most regions. Yet, given the amount of variability found in grazing costs, both within and between regions, it was not surprising that statistical differences were not found.

Methods for Updating Forage Values

Any method of determining forage values and the resulting grazing fees will be subject to future discrepancies. Forage markets are dynamic systems dependent upon national, regional and local conditions which impact the supply and demand for the product. Weather conditions, livestock numbers, alternative forage markets and many other factors influence rangeland forage values. These factors vary from time period to time period (which may not be annually).

Table III-14. Comparison of costs per AUM of grazing cattle¹ on private, BLM and USFS land by eco-physiographic regions, 1992.

Eco-Physiographic Region	Private	BLM	BLM Forage Value	USFS	USFS Forage Value
Northern Rocky Mountains	13.98 (2.64,16)	9.33 (4.94,14)	4.65 ^a ± 9.19 (5.41)	18.60 (3.12,13)	-4.62 ^a ± 6.90 (4.06)
Middle Rocky Mountains	14.10 (2.46,25)	26.10 (5.94,13)	-12.00 ^b ± 9.26 (5.45)	15.58 (2.80,13)	-1.48 ^a ± 6.75 (3.97)
Wyoming Basin	18.96 (2.17,19)	14.25 (1.58,45)	4.71 ^a ± 4.70 (2.81)	*	*
Southern Rocky Mountains	18.92 (3.29,4)	16.33 (4.48,9)	2.59 ^a ± 12.73 (7.19)	25.60 (3.47,12)	-6.68 ^a ± 11.20 (6.40)
New Mexico Plateaus & Mesas	23.90 (2.44,9)	18.19 (2.36,8)	5.71 ^a ± 5.94 (3.41)	23.60 (2.83,4)	0.30 ^a ± 7.35 (4.15)
Southern Desertic Basins	18.52 (1.14,11)	14.66 (1.92,17)	3.86 ^a ± 4.37 (2.57)	24.63 (2.30,4)	-6.11 ^a ± 4.07 (2.33)
Colorado Plateau	24.06 (4.13,9)	14.09 (4.56,7)	9.97 ^a ± 10.80 (6.17)	22.58 (2.85,4)	1.48 ^a ± 11.68 (6.60)
Intermountain-Columbia Plateau	21.25 (3.87,11)	12.61 (1.29,25)	8.64 ^a ± 5.36 (3.19)	26.00 (4.10,5)	-4.75 ^a ± 11.24 (9.16)
Palouse Grassland	21.20 (5.51,6)	*	*	16.58 (7.64,4)	4.62 ^a ± 16.58 (9.16)

Note: Forage values in the same column that are followed by the same letter are not statistically different at the $\alpha = 0.10$ level. Grazing costs are not tested statistically because the number of possible combinations is excessive. Means in the same row are not compared statistically. The numbers in parenthesis are the standard error of the mean and the sample size. Forage value is shown as the mean value with 90% confidence limits about the mean.

*Insufficient data to estimate mean.

¹/Insufficient data to estimate costs per AUM for sheep.

The tracking ability of the existing PRIA formula, and other fee formulas proposed to include different ability-to-pay indices (ICI or ratios between BCPI and PPI/ICI), are a concern for grazing fee policy. Other topics related to updating and indexing forage values include the validity of the FVI at the state level (Torell et al. 1989, Rimbey et al. 1992) and the need for and the functional form of ability-to-pay indices included in any updating formula.

It has traditionally been held that a desirable grazing fee system should: 1) maintain the fee at current market value and 2) consider ranchers' ability-to-pay. The FVI captures annual variations in the private lease market and the other two PRIA indices (BCPI and PPI) measure profitability or ability-to-pay. However, this interpretation was not the original reason for including the BCPI and PPI in the formula. It was originally believed that the private grazing land lease rate (FVI) would adequately track the long-term trend in grazing values. However, an Interdepartmental Grazing Fee Technical Committee assigned to study grazing fee alternatives in the 1960's questioned the ability of the FVI to account for short-term demand, supply, and price disequilibrium (USDA/USDI 1977, p. 3-34). For this reason, the Technical Committee recommended adding the BCPI and PPI to the fee formula.

Over 25 years of data are now available to evaluate which indices have been important in explaining annual variation in forage values and to evaluate whether adding the BCPI and PPI indices to the PRIA fee formula did in fact help explain short-term market fluctuations. This type of analysis was conducted by Brokken and McCarl (1985), Rimbey (1990) and Torell et al. (1989). Regression results generally showed that the FVI has been the most important factor in explaining annual variation in private lease rates, but changes in BCPI and PPI further explained short-term variation in forage value in some of the western states (Brokken and McCarl 1985).

Including BCPI and PPI in the PRIA formula has caused the calculated grazing fee to fall further and further behind forage value through time (USDA/USDI 1992). With an equal weighting of 1.0 for each of the indices and the continued upward movement of the PPI index, grazing fees derived through the PRIA formula do not track private land lease rates (USDA/USDI 1992). Had the \$1.23 base fee been indexed by only the FVI, the grazing fee would have been \$3.26 in 1992 (USDA/USDI 1992). This is 70 percent higher than the 1992 grazing fee of \$1.92 per AUM. Since 1979, the inclusion of the combined index has resulted in a reduction of the grazing fee by \$0.85 per AUM, whereas forage value has actually increased by \$0.49 per AUM (USDA/USDI 1992, Figure 3.2).

If a variable fee is established, there is also the issue of how to update regional or state-level forage values. PRIA uses the USDA-NASS eleven western state average of the FVI. The NASS value is derived by weighting the values by the number of observations (farm units.). This value is considered a reliable estimate of the change in the private land lease rate westwide. One alternative would be to use this westwide value to update each

pricing area (regional) value. Using the same index number to update each pricing area would of course update each area the same, which may not reflect the true situation. The value in one pricing area may be changing faster than in another, raising the issue of fairness in indexing.

To account for differences in value by pricing area, one option is to use the individual state private land lease rates as reported by NASS. However, this may not be satisfactory unless the NASS data gathering effort is expanded. It is generally recognized that the state values may not be reflective of changes in forage value at the state level because of the limited sample size and the way the data is collected. Another option is to derive an average westwide value that is more reflective of changes by state by weighting the individual state lease rates by the number of federal AUM's in that state rather than by the number of private lease observations, as is presently done. This was one of the technical modifications suggested in the 1986 grazing fee study (USDA/USDI 1986).

Even if a valid estimate of forage value can be made and an equitable and efficient grazing fee is set at an initial point in time, the process of keeping the grazing fee current with market conditions must be addressed. Brokken and McCarl (1987) stated, "An initially efficient equitable fee system will probably not remain so for more than a few years." This concern applies to any of the methods of indexing grazing fees, with the possible exception of competitive bidding.

As a method of testing tracking performance for alternative fee systems, Brokken and McCarl conducted regression analysis on the various indices in the existing PRIA fee formula. In addition, Rimbey (1990) and Torell et al. (1989) used the same approach at the state level. Results of these analyses indicate potential for evaluating indices for updating forage values.

The goal of any tracking mechanism should be to keep the fee at the market rate. NASS lease rates are considered to be reflective of the competitive forage market¹⁹. Given these two conditions, regression equations can be estimated to evaluate how much different indices have contributed to tracking ability. The FVI, which tracks private lease rates, can be defined as the dependent variable and other lagged indices as independent variables. The following regression equations were estimated using different NASS-reported indices. Those variables preceded by "ID" (eg. IDFVI_t) refer to data from Idaho, "NM" from New Mexico and "WY" from Wyoming. Variables without a prefix use data from the 11 western states. Equations are included that replace PPI with the ICI because

¹⁹The market values of public land forage is less than reported private land lease rates because of higher non-fee costs on public lands and other differences in lease terms and conditions. However, if forage value is some constant fraction less than private lease rates, then NASS lease rates still provide an indication of market changes and, thus public land forage values. Results from this study indicate that the average BLM cattle in Idaho (Table III-4) was 48% below NASS rates (\$4.55 versus \$9.49), 51% lower in New Mexico (\$3.52 versus \$6.95) and 51% lower in Wyoming (\$3.46 versus \$9.93).

this alternative was recommended in the most recent federal grazing fee report (USDA/USDI 1992). The functional format for this relationship is:

$$FVI_t = f(FVI_{t-1}, BCPI_{t-1}, PPI_{t-1} \text{ or } ICI_{t-1})$$

where:

FVI_t	=	Forage Value Index in year t
FVI_{t-1}	=	Forage Value Index in year t-1
$BCPI_{t-1}$	=	Beef Cattle Price Index in year t-1
PPI_{t-1}	=	Prices Paid Index in year t-1
ICI_{t-1}	=	Input Cost Index in year t-1

Brokken and McCarl's regression analysis used a west wide data set of the indices and covered the period from 1964 through 1982. We used a similar procedure to update the regression equations through 1992. Estimated equations were as follows:

$$(1) FVI_t = 1.5101 + 0.8880 FVI_{t-1} + 0.1914 BCPI_{t-1} - 0.0583 PPI_{t-1}$$

(10.17)[#] (0.172)^{*} (0.066)^{*#} (-0.7663)[#]

$$R^2 = 0.97751, F = 406.635$$

$$(2) FVI_t = 6.0734 + 0.9998 FVI_{t-1}$$

(5.98)[#] (0.032)^{*}

$$R^2 = 0.97189, F = 968.926$$

$$(3) IDFVI_t = -5.7817 + 1.0885 FVI_{t-1} + 0.2492 BCPI_{t-1} - 0.2396 PPI_{t-1}$$

(-17.49)[#] (0.295)^{*} (0.113)^{*#} (-0.131)[#]

$$R^2 = 0.92276, F = 112.504$$

$$(4) IDFVI_t = 18.8276 + 0.8975 FVI_{t-1}$$

(10.11)[#] (0.054)^{*}

$$R^2 = 0.90686, F = 273.63$$

$$(5) NMFVI_t = 19.4722 + 1.3390 FVI_{t-1} - 0.1790 BCPI_{t-1} - 0.2773 PPI_{t-1}$$

(28.66)[#] (0.485)^{*} (0.185)[#] (0.215)[#]

$$R^2 = 0.62343, F = 16.452$$

$$(6) NMFVI_t = 53.0594 + 0.5520 FVI_{t-1}$$

(15.31)^{*#} (0.082)^{*#}

$$R^2 = 0.61155, F = 45.081$$

$$(7) \text{ WYFVI}_t = -29.7161 + 1.5285 \text{ FVI}_{t-1} + 0.1722 \text{ BCPI}_{t-1} - 0.3525 \text{ PPI}_{t-1}$$

(18.53)[#] (0.313)^{*#} (0.120)[#] (0.139)^{*#}

$$R^2 = 0.93119, \quad F = 127.315$$

$$(8) \text{ WYFVI}_t = 8.6189 + 1.0119 \text{ FVI}_{t-1}$$

(10.77)[#] (0.053)^{*}

$$R^2 = 0.91604, \quad F = 306.487$$

$$(9) \text{ PPI}_t = -78.6004 + 1.6962 \text{ ICI}_t$$

(11.05)^{*#} (0.052)^{*#}

$$R^2 = 0.97446, \quad F = 1069.245$$

$$(10) \text{ FVI}_t = 7.0615 + 0.8292 \text{ FVI}_{t-1} + 0.1893 \text{ BCPI}_{t-1} - 0.0480 \text{ ICI}_{t-1}$$

(6.82)[#] (0.23)^{*} (0.067)[#] (0.186)[#]

$$R^2 = 0.97704, \quad F = 398.19$$

$$(11) \text{ IDFVI}_t = 27.8161 + 0.2759 \text{ FVI}_{t-1} + 0.2159 \text{ BCPI}_{t-1} + 0.2942 \text{ ICI}_{t-1}$$

(12.17)^{*#} (0.42)[#] (0.119)[#] (0.536)[#]

$$R^2 = 0.91508, \quad F = 101.573$$

$$(12) \text{ NMFVI}_t = 49.1447 + 0.8858 \text{ FVI}_{t-1} - 0.1963 \text{ BCPI}_{t-1} - 0.0785 \text{ ICI}_{t-1}$$

(19.62)^{*#} (0.67) (0.192)[#] (0.526)[#]

$$R^2 = 0.5986, \quad F = 14.919$$

$$(13) \text{ WYFVI}_t = 3.008 + 1.2169 \text{ FVI}_{t-1} + 0.1617 \text{ BCPI}_{t-1} - 0.3274 \text{ ICI}_{t-1}$$

(13.58)[#] (0.463)^{*} (0.133)[#] (0.371)[#]

$$R^2 = 0.91603, \quad F = 102.812$$

R^2 values are adjusted for degrees of freedom. Numbers in parentheses are standard errors. Equation parameters significantly different from zero at a 0.10 confidence level are noted by *, and those significantly different from 1 are designated by #.

In general, a large amount of the variation in private land lease rates (as defined by the FVI) is explained by variation in the indices currently in the PRIA fee formula. Obviously, variation in FVI is most closely correlated with FVI_{t-1} . This index was nearly always significant in explaining variation in NASS lease rates.

Always significant in explaining variation in NASS farm sales.
Obviously, variation in FVI is most closely correlated with FVI₁. This index was nearly
the FVI is explained by variation in the index currently in the FRIA for formula
In general, a large amount of the variation in private land lease rates (as defined by
for *, and those significantly different from 1 are designated by Δ.
Regression parameters significantly different from zero at a 0.10 confidence level are noted.
R² values are adjusted for degrees of freedom. Numbers in parentheses are standard errors.

$$R^2 = 0.91802, F = 102.812$$

$$(13) \text{ WYFVI} = 2.008 + 1.216 \text{ FVI}_1 + 0.161 \text{ BCP}_1 - 0.374 \text{ ICI}_1$$

$$(15.28)^* (0.082)^* (0.133)^* (0.371)^*$$

$$R^2 = 0.9268, F = 14.919$$

$$(12) \text{ MFGVFI} = 69.1447 + 0.238 \text{ FVI}_1 - 0.1963 \text{ BCP}_1 - 0.078 \text{ ICI}_1$$

$$(12.62)^* (0.67)^* (0.193)^* (0.252)^*$$

$$R^2 = 0.91202, F = 101.213$$

$$(11) \text{ IDEVFI} = 2.83101 + 0.179 \text{ FVI}_1 + 0.2155 \text{ BCP}_1 + 0.1943 \text{ ICI}_1$$

$$(12.17)^* (0.42)^* (0.119)^* (0.236)^*$$

$$R^2 = 0.97704, F = 208.19$$

$$(10) \text{ FVI} = 7.0815 + 0.201 \text{ FVI}_1 + 0.1893 \text{ BCP}_1 - 0.0420 \text{ ICI}_1$$

$$(0.82)^* (0.23)^* (0.067)^* (0.182)^*$$

$$R^2 = 0.97465, F = 198.245$$

$$(9) \text{ FVI} = -28.6004 + 1.9982 \text{ ICI}_1$$

$$(11.05)^* (0.002)^*$$

$$R^2 = 0.91608, F = 200.457$$

$$(8) \text{ WYFVI} = 8.9188 + 16.112 \text{ FVI}_1$$

$$(10.77)^* (0.002)^*$$

$$R^2 = 0.93119, F = 127.512$$

$$(7) \text{ WYFVI} = -20.7101 + 1.5283 \text{ FVI}_1 + 0.1722 \text{ BCP}_1 - 0.1528 \text{ FVI}_1$$

$$(18.22)^* (0.212)^* (0.120)^* (0.138)^*$$

As shown by the equations, little is gained by adding $BCPI_{t-1}$ and PPI_{t-1} to the equations. The $BCPI_{t-1}$ was only different from zero for the westwide equations (1 and 10) and for Idaho with PPI (3). The PPI_{t-1} was only different from zero for Idaho and Wyoming. Further, and perhaps most important, both BCPI and PPI were different from one (1) in nearly all cases. This means that if BCPI and PPI are used in a tracking formula, they should not be given a coefficient (or weighting) of 1 if tracking ability of the equation is to be maintained.

Because private land lease rates (FVI_t) are closely correlated with lease rates during the previous year (FVI_{t-1}), the most obvious recommendation would be that public land grazing fees be updated by simply using the FVI index. In most cases, the estimated coefficient for FVI_{t-1} is not significantly different from 1. The regression equations indicate that BCPI and PPI should be dropped from the updating process and FVI_{t-1} is the most significant variable in any of the equations. Adding the BCPI and PPI to the PRIA formula did not improve the tracking ability of the formula as anticipated by the Grazing Fee Technical Committee in the 1960's (USDA/USDI 1977, p. 3-34). In fact, adding these two indices greatly diminished the tracking of forage value through time.

The limitations of the USDA-NASS private lease rates (particularly, state-level figures) should be evaluated. Several authors (Torell et al. 1989, Rimbey et al. 1992) have studied private grazing leases in western states. These studies, and this study, have derived market-based estimates of private lease rates which differ substantially from the USDA-NASS rates. Both Brokken and McCarl (1987) and this analysis indicate some sacrifice of predictability when attempting to derive state-level equations and the FVI needs to be improved, especially if regional or state-level estimates of value are used to adjust to an area-specific grazing fee.

CHAPTER IV

DISCUSSION AND CONCLUSIONS

In this Chapter, the results of the preceding analyses are compared and then evaluated against the criteria from Chapter I. Based on this comparison and evaluation, recommendations are presented in Chapter V regarding methods for establishing the grazing fees, updating the fees periodically and determining pricing areas.

Discussion of Criteria

Valuation of Forage

Various approaches were used in this study to estimate the value of public land forage, including the total cost approach, a market appraisal of private land lease rates, statistical analysis of lease rates and grazing costs, indexing of the 1966 forage value estimate (\$1.23/AUM) to a 1992 value, and a direct estimate of value from grazing permit values. 1992 forage value estimates for cattle on BLM ranged from over \$7.00/AUM in Idaho and Wyoming to negative values for cattle and sheep on USFS and for sheep on BLM. Most of the estimates for cattle grazing on BLM land were in the range of \$3 to \$5/AUM.

Table IV-1 summarizes the values obtained using alternative methods. Table IV-2 summarizes the advantages, disadvantages and limitations for each forage valuation procedure studied. A more detailed discussion is provided below.

Theoretical justification for valuation methods that compare to the private forage market comes from standard economic models and principles that describe the motives of profit maximizing firms (ranches). These methods are justified based on certain limiting assumptions: 1) ranchers are profit maximizers, 2) ranchers have at their disposal numerous alternative forage sources and leasing alternatives (i.e., private and public forage are direct substitutes), and 3) rational and economically-motivated livestock producers are willing to pay a price equal to the value of forage in production. It would be expected that if the competitive forage market was efficient, public and private grazing costs would be equal and the capitalized value of the grazing permit would equate any cost differentials that existed.

If only forage values for cattle grazing BLM land are considered, this economic scenario would appear to hold. Considering specifically the total cost approach, non-fee grazing costs on BLM lands were found to average \$3.63/AUM less than grazing costs on private leased lands after adjusting to the same lease size and averaging across all three test states. With the 1992 public land grazing fee at \$1.92/AUM, an excess value of

Table IV-1. Comparison of forage value estimates using various valuation approaches, 1992.

		Estimated Forage Value						
		Total Cost Approach	Market Appraisal Approach	Market Statistical Approach	Permit Value	1992 ICI Indexed	1990-92 ICI Indexed	1992 Various Indices
1. Test States								
C a t t l e	BLM	3.63 ± 2.42						
	USFS	-2.86 ± 2.59						
	BLM and USFS	0.89 ± 2.06				3.39	3.20	2.81
S h e e P	BLM	-2.77 ± 6.22						
	USFS	-12.22 ± 6.94						
	BLM and USFS	-5.41 ± 5.87				3.01	2.82	2.14
B o t h	BLM	2.85						
	USFS	-3.98						
	BLM and USFS	0.13				3.34	3.15	2.73
2. State - Idaho								
C a t t l e	BLM	4.55 ± 3.69		8.42	3.16			
	USFS	-3.78 ± 5.09			3.32			
	BLM and USFS	2.72 ± 3.45			3.19			
S h e e P	BLM	-10.92 ± 11.16						
	USFS	-7.24 ± 8.69						
	BLM and USFS	-8.79 ± 9.50						

Table IV-1. Continued.

		Estimated Forage Value						
		Total Cost Approach	Market Appraisal Approach	Market Statistical Approach	Permit Value	1992 ICI Indexed	1990-92 ICI Indexed	1992 Various Indices
3. State - New Mexico								
Cattle	BLM	3.52 ± 2.54	3.40	4.79	4.90			
	USFS	-5.13 ± 2.58			4.33			
	BLM and USFS	-0.48 ± 2.32			4.68			
Sheep								
P	BLM	12.34 ± 6.14						
	USFS							
	BLM and USFS							
4. State - Wyoming								
Cattle	BLM	3.46 ± 3.43	7.19	6.93	3.09			
	USFS	2.13 ± 4.60			3.53			
	BLM and USFS	3.11 ± 3.34			3.16			
Sheep								
P	BLM	1.65 ± 6.82						
	USFS	-7.47 ± 8.60						
	BLM and USFS	-0.05 ± 6.57						

Note: Means computed for BLM and USFS combined are weighted by the number of AUM's included in the 1992 grazing cost survey for each land agency (Figure II-2). Means computed for both cattle and sheep are weighted by the proportion of cattle (88%) and sheep AUM's (12%) included in the grazing cost survey.

\$1.71/AUM ($\$3.63/\text{AUM} - \$1.92/\text{AUM} = \$1.71/\text{AUM}$) was apparently capitalized into a grazing permit value and ranchers were paying equal amounts for grazing public and private lands²⁰. The major question in this situation is the allocation of this excess value. The 1992 grazing fee of \$1.92/AUM captured the market value of the forage if the rancher's investment in the grazing permit is recognized. Yet, legal precedence says that permit value (cost) need not be considered when setting grazing fee policy (Pankey Land and Cattle Co. v. Hardin and Hickel, Cite 427 F.2d 43 1970).

Negative forage value estimates as found for USFS and BLM sheep allotments were not economically logical. In these cases, grazing costs were found to be higher, on average, than for private lands. Yet, profit-motivated ranchers should not be willing to pay more for grazing public lands if private leases are available at a lower cost. The fact that USFS permits and some sheep permits continue to have a real estate value furthers the argument that profit is not the sole motive²¹.

It is our perception that the data collected for the grazing cost survey were valid and that the cost estimates as presented do in fact reflect the current situation. Grazing costs are extremely variable and many public land ranchers are paying more than private land lessees for grazing, even before considering grazing permit investments. Yet, one must question the validity of forage values derived using the total cost approach, and other methods that make comparisons with the private forage market, if ranchers are not motivated primarily by profit. It is not possible to know what price ranchers would pay for grazing public lands if a framework such as profit maximization cannot be assumed. In this case, comparison to the private forage market does not provide public land forage value because the motives of ranchers are not adequately incorporated. What ranchers would or would not pay for public land forage cannot be determined without establishing a competitive market.

Rejecting the total cost approach as a method of valuing forage does not mean that grazing cost comparisons that were made between private and public land ranchers are not useful. The findings are significant. It was estimated that with the 1992 grazing fee of \$1.92/AUM, 34% of cattle producers on BLM land, 62% of USFS cattle producers, 60% of BLM sheep producers and 92% of USFS sheep producers paid more in total for grazing public lands than did those leasing private lands (Figures III-2 and III-3). Additional investments were also made to buy the grazing permit. The common belief that public land ranchers pay less than those leasing private lands is not justified in most cases.

²⁰ Much variability was found, however, and grazing cost estimates for individual grazing allotments ranged from -\$74/AUM to +\$20/AUM (Figures III-2 and III-3). Permit values also varied considerably.

²¹ It appears that some sheep permits do not have economic value. Vacant sheep permits exist in nearly all of the western states. The uncertainty about grazing fee policy and other public land policies has reduced permit values (Torell and Doll 1991).

The market appraisal approach and the market statistical approach are based on the alternative cost doctrine: a rational and profit motivated rancher will not pay more to lease forage than what must be paid to lease the next best alternative. To use these valuation methods again requires one to assume that ranchers' economic decisions are consistent with profit maximization and that they are knowledgeable about the costs of using public forage. Further, private leases must be directly comparable in location and other attributes that affect value and numerous leasing alternatives must exist. This was not found to be the case when compared to USFS lands. Very few comparable leases could be found for the market appraisal valuation, and none were considered comparable to USFS lands. Average forage values estimated from the market statistical approach were \$4.79/AUM in New Mexico, \$8.42/AUM in Idaho and \$6.93/AUM in Wyoming, and forage values estimated from the market appraisal approach were \$3.40 for New Mexico and \$7.19 for Wyoming (Table IV-1).

The limited number of private leases that are truly comparable to public lands, without major adjustment, limits the use of the market appraisal approach. This was the case here and in other recent grazing fee studies (USDA/USDI 1986, 1992). Thousands of leases were included in the 1986 grazing fee study but in the end an arbitrary adjustment of 5% was made for the difference in services provided with private land leases that were not provided on public lands.

Even if differences in the value of lessor-provided services can be accounted for using regression techniques, the estimate of net forage value is still not necessarily comparable to public lands. The market statistical approach does not require that only non-serviced leases, similar to public land leases, be considered. Rather, serviced and non-serviced private leases are included and variation in the lease price as services are and are not provided gives a direct estimate of the value of these services, and of net forage value. The estimate of forage value, however, is for non-serviced private leases not non-serviced public leases. In addition to services provided, if location, terrain or other attributes affecting value are different between private and public lands, then an appropriate adjustment must still be made.

Amortized grazing permit values added to the 1992 grazing fee indicated the market value of forage was in the \$3/AUM range in Idaho and Wyoming and in the \$4/AUM range in New Mexico (Table IV-1). These estimates are comparable to the \$3 to \$5/AUM value estimated using the total cost approach for BLM cattle grazing. These values are a direct estimate of how much ranchers were willing to pay for public land forage in 1992.

As was true for other valuation methods described above, justification for the permit value method comes from standard economic models of profit maximization. Permit value should be the factor that equates total grazing costs to value, and there is a strong theoretical linkage between grazing fees and permit value.

Two critical factors limit using permit values to estimate forage value. First, while permit value can be estimated by analyzing ranch sales data or by querying knowledgeable individuals, a subjective interest rate is used to compute an annual forage value. Wide variation in value will be obtained depending on the selected interest rate. Second, permit values have not been a consistent indicator of value and factors associated with livestock grazing explain only part of the variation in the value of grazing permits (Jensen and Thomas 1967, Torell and Doll 1991).

Federal agencies contend that permit value belongs to the federal government and therefore have not considered permit value in setting grazing fee policy. Yet, allocation of permit value lies at the heart of the grazing fee debate. Private markets and past policies have allocated this value to ranchers; higher grazing fees would reallocate this value to the government. Concerns about the fairness of this reallocation are obvious.

Indexing the \$1.23/AUM forage value that was set in 1966 would be one alternative that could be used to update grazing fees. This assumes that the \$1.23/AUM value was correct in 1966 and remains correct today, except for the inflationary changes in the value. Indexed forage values estimated here ranged from \$2.14/AUM for sheep to \$3.39/AUM for cattle (Table IV-1).

Indexed forage values were not statistically different from current estimates using the total cost approach. However, the 1966 value was set using the total cost approach. As discussed above, the negative estimates of value in the current study suggests that the total cost approach is limited in its usefulness in valuing public land forage. Indexing of previous values must be rejected for the same reasons that we discount current estimates of value from the total cost approach. The indexing approach was also discounted because the indexed costs and indexed private lease rates were less than current values.

We started this study thinking that a comparison to the private forage market was the best way to value public land forage. We ended the study with the renewed realization that public land ranchers participate in the livestock business for a number of reasons that are not necessarily related to profit. Other factors, including the way of life, are important in the decisions western ranchers make (Smith and Martin 1972). This being the case, there is no theoretical justification for setting grazing fees based on a comparison to the private forage market. These valuation approaches do not consistently meet the criterion of collecting the market value of forage. This leaves competitive bidding or a politically negotiated fee as the only alternatives.

We did not study competitive bidding in detail because no test or evaluation can be made without major changes in existing policy. Except for the few existing areas using competitive bidding (e.g. McGregor Range and Fort Meade), moving to this system could

Table IV-2. Summary of advantages, disadvantages and limitations found for various forage valuation methods.

Valuation Method	Major Advantages	Major Disadvantages	Estimates Market Value of public land forage?		Critical Limitation
			In Theory	In Practice	
Permit Value	1. Provides a direct and site specific estimate of forage value on public lands.	1. Requires a subjective selection of an interest rate to use in determining value. 2. Ranchers have paid more for grazing permits than justified from potential ranch profits, i.e., value estimates have been inconsistent.	Yes	No	Subjective selection of interest rate to use
Indexing of 1966 Values	1. Large sample of private and public land ranchers were used to estimate 1966 forage value. Data were included from all western states.	1. Assumes 1966 forage value of \$1.23/AUM was correct and can be indexed to current value. 2. Requires assumption that ranchers are profit maximizers.	Yes	No	Uses the total cost approach and is therefore limited by the same theoretical/empirical limitations.
Competitive Bidding	1. The marketplace provides the final determination of value. A competitive bid would create a direct market for public land forage. 2. The need to define pricing areas and develop an adjustment mechanism would be eliminated.	1. Moving to a competitive bid system represents a major change in policy. Public land grazing permits have been allocated and permits have value to the current holder. A way of equitably reallocating permits to other potential lessee's must be devised. 2. There must be ample competition for individual parcels of public land to assure a true market price is established. Yet, some public land is scattered with other private and state trust lands. Few people other than the current lessee could potentially bid for the forage.	Yes	Unknown	Represents a major policy shift that will not be equitable in all cases. Many questions arise as to how a competitive system would work.

Table IV-2. Summary of advantages, disadvantages and limitations found for various forage valuation methods.

Valuation Method	Major Advantages	Major Disadvantages	Estimates Market Value of public land forage?		Critical Limitation
			In Theory	In Practice	
Total Cost Approach	<ol style="list-style-type: none"> 1. Considers grazing costs on both private and public lands. 2. Recognizes differences in characteristics and quality between public and private lands to the degree that these differences are reflected in grazing costs. 	<ol style="list-style-type: none"> 1. Assumes ranchers make rational economic decisions that are consistent with profit maximization. This study did not find this to be the true. Without the assumption of profit maximization, traditional models will not reveal how much ranchers would pay for public land forage under a competitive market system. 	Yes	No	Empirical results are not consistent with the theoretical justification for the valuation approach.
Market Appraisal Approach	<ol style="list-style-type: none"> 1. Data only need be collected on comparable private land leases. 	<ol style="list-style-type: none"> 1. Does not directly consider the characteristics of public lands but rather assumes private leases are comparable or that differences can be adjusted for. Requires that only nonserviced and comparable private land leases be used in the appraisal of value. 2. Relies on subjective appraisal adjustments to arrive at public forage value. 3. Requires the assumption of profit maximization. 	<p>Yes</p> <p>When adjusted for differences</p>	No	Few private land leases are comparable to public lands. Subjective adjustments must be made. Profit maximizing behavior must be assumed.
Market Statistical Approach	<ol style="list-style-type: none"> 1. Data only need be collected on comparable private land leases. 2. Does not rely on subjective appraisal techniques to adjust to nonserviced lease basis. 3. Sample size is larger because serviced and non-serviced private leases can be included in the statistical evaluation. 	<ol style="list-style-type: none"> 1. The statistical evaluation adjusts values to a nonserviced basis but makes no adjustment for additional differences between private and public lands. 2. Requires the assumption that ranchers are profit maximizers. 	<p>Yes</p> <p>When adjusted for differences</p>	No	Estimated forage value is for a non-serviced private lease not public lands.

Continued

mean a major reallocation of grazing permits. The variability that we found in grazing costs, and the variability that was present in the 1966 grazing fee study suggests each grazing parcel has its own unique value. Establishing a competitive market through some type of bidding scheme appears to be the only way to discover what these values are.

Many questions come to mind as to how a competitive bid system might be structured and implemented. What should be done with existing permit holders and the asset values of permits? What should be the terms of the lease, the length of the lease period, and what qualifications and requirements should be set before a bid can be submitted? Should there be a commensurate property requirement? What provisions, if any, should be made for minimum and maximum bids? How should parcels with a limited number of prospective bidders be dealt with? The list goes on and on, but, results of our study indicate the competitive lease option may provide an economically rational way to discover the market value for grazing on public lands.

Another option would be to politically negotiate a fee using our results as a guide to public forage values. Any regional differences in the negotiated fee would have to be based on non-economic criteria as economic pricing regions were not apparent from our study results. A different fee for cattle and sheep and a different fee for BLM and USFS may be justified but wide variation in values precludes selection of an exact number.

Establishing Grazing Fees

Net Payments to State and County Government. Changing how public land grazing fees are determined could impact revenues received by local counties and states through various federal payment programs. These payments are comprised of a combination of receipts based on the distribution formulae for the management agency and the Payment in Lieu of Taxes Act of 1976 (PILT Act, PL 94-565). The USFS grazing fees are distributed on the basis of 25% of the gross receipts being allocated to the counties on the basis of relative acreages that are contained within the USFS management unit. BLM has two separate funding distribution formulae, with 50% of total grazing fee receipts being distributed to counties with Section 15 lands and 12.5% distributed to counties with Section 3 lands. Both of these distributions are again determined on the basis of relative county acreages within the management unit.

Under the PILT Act, Congress provided for payments to local units of government containing certain federally-owned lands. These payments are designed to provide counties which are comprised of public lands with revenue sources to alleviate local property tax revenue losses. The payments also supplement other federal revenue sharing which local government receive and may be used for any governmental purpose. In some cases, fee distributions and PILT payments may be offsetting in their effect.

The PILT Act authorizes payments under one of two alternatives, based on the number of acres of entitlement land within the county and subject to a payment ceiling

based on county population. The amount paid to the county would be the higher of the two alternatives (subject to the ceiling):

A) PILT Payment = (entitlement acres in the county \times \$0.75/acre) - prior year's payment

B) PILT Payment = entitlement acres in the county \times \$0.10/acre

Under Alternative A the total calculated payment is reduced by the amount of certain federal land payments that were received by the county in the preceding fiscal year, also called "prior year's payments." These include payments made to the county from national forest receipts, mineral leasing, sales of land and materials, and grazing fee receipts, to name a few. If the calculated payment exceeds the payment ceiling, deductions for prior year's payments are made from the ceiling, not from the total calculated payment.

For Alternative A, a decrease (increase) in grazing fee receipts would cause a corresponding increase (decrease) in the county's PILT payment. Consequently, total revenues paid to the county would be unaffected under this alternative, all other factors remaining constant. This relationship would hold even if a payment ceiling were in effect for the county.

Under Alternative B, no deductions are made for prior year's payments (such as grazing fee receipts) received by the county. Consequently, a decline in grazing fee receipts would cause a corresponding decline in total federal revenues to those counties whose PILT payments fall under the Alternative B formula. However, the reverse would also be true: an increase in grazing fee receipts would cause a corresponding increase in total federal revenues to these counties. This relationship would hold even if a payment ceiling were in effect for the county.

Table IV-3 contains results of an evaluation of federal PILT payments received by each county in the 16 Western states during fiscal year 1992. These results indicate how PILT payments were calculated for fiscal year 1992 based on the method (Alternative A or B, above) used to calculate each county's federal PILT payments. They indicate also whether or not changes in grazing fees may affect county PILT payments. These results indicate that 546 (76%) of counties in the 16 Western states received payments under Alternative A during fiscal year 1992, and on that basis, most likely would not be affected by moderate changes (increases or decreases) in grazing fee rates. The remaining 175 counties (24%) could be affected to some degree by changes in grazing fee rates. States with a large percentage of counties that use Alternative B to calculate PILT's may be impacted by this change in grazing fees. These states include California, Colorado, Nevada, Oregon and Washington.

The extent of change in grazing fee receipts, and therefore, potential change in state and local payments under Alternative B, would also depend on the relationship between the amount of grazing fee change and the number of livestock permittees that would be willing

Table IV-3. Counties receiving PILT payments in the 16 Western states, 1992.

State	Number of Counties and Percentage	
	Alternative A	Alternative B
California	27 (47%)	31 (53%)
Colorado	31 (54%)	26 (46%)
Idaho	30 (68%)	14 (32%)
Kansas	41 (93%)	3 (7%)
Montana	46 (82%)	10 (18%)
Nebraska	45 (100%)	0 (0%)
Nevada	10 (59%)	7 (41%)
New Mexico	31 (97%)	1 (3%)
North Dakota	44 (92%)	4 (8%)
Oklahoma	57 (93%)	4 (7%)
Oregon	3 (9%)	32 (91%)
South Dakota	40 (95%)	2 (5%)
Texas	82 (89%)	10 (11%)
Utah	26 (90%)	3 (10%)
Washington	13 (34%)	25 (66%)
Wyoming	20 (87%)	3 (13%)
Total Counties	546 (76%)	175 (24%)
Total States	13 (81%)	3 (19%)

Source USDI (1992).

to graze at the revised fees. If a small increase in the fee caused a relatively large decrease in animals grazed, the overall effect would be a relatively large decline in receipts to the federal treasury and to overall state and county payments. If animals grazed remained essentially unchanged, the overall payments under Alternative B would change proportionately to the change in the grazing fee.

Program Cost Recovery. The cost elements involved in administering the grazing program are allotment planning and inventory, use supervision and management, and program management. The 1992 grazing fee report showed total rangeland costs to be \$3.21 and \$3.24/AUM for BLM and USFS, respectively in 1990 (USDA/USDI 1992, p.5). The costs associated only with livestock grazing were \$2.18/AUM for BLM and \$2.40/AUM for USFS (USDA/USDI 1992, p.6).

The total cost approach estimated forage values for USFS and sheep production that were less than these administrative costs. Thus, this method of forage valuation would not meet the criteria of covering program costs in all cases. The \$3 to \$5/AUM range obtained from other methods would cover the costs of administration previously identified.

Administrative Feasibility. Using a market comparison to value public land forage is understandable by land agencies and the general public. Private land lease rates were used to imply the value of National Forest lands as early as 1915 (Rachford 1924, p. 4). We found ranchers were willing to provide reliable cost data. The number of comparable private land leases were found to be limiting for valuation of USFS lands and for sheep producers. The lack of comparable private leases would likely preclude use of the market price comparison in states like Nevada and Arizona that do not have many private land leases.

Competitive bidding would require clearly defined rules and regulations about how the system was implemented. This method might not be feasible on scattered parcels where market competition would be limited.

Updating Grazing Fee

Maintain market value over time. As stated above, it is desirable that any grazing fee system should maintain the fee at current market value. Our analysis and that reported by USDA/USDI (1986) indicate that the Forage Value Index (FVI) is the most important factor for updating forage values. The preferred method for updating forage values would be to use only the previous year's FVI to index the grazing fee. Inclusion of the BCPI and PPI in the PRIA formula suppresses the indexed forage value over time and does not adjust for short-term market imperfections as originally envisioned. Periodic evaluation of the performance of the indexing formula will be needed.

Ability-to-Pay. If an updating mechanism such as the FVI equation is used to adjust current grazing fees for fluctuations in the forage market, both upward and downward, it is felt the adjusted grazing fee would recognize ability-to-pay. A profit-motivated ranchers' willingness-to-bid for forage must directly consider expected livestock prices and production costs. We do not believe that over the long-term, private land lease rates will be significantly different from what profit potential will allow, even if many ranchers are motivated by factors other than profit. Thus, there is no justification to include BCPI and PPI, the "ability-to-pay indices".

Determination of Pricing Areas

Five pricing areas were considered by the GFTG. They included: 1) single or national area, 2) ecological areas, 3) economic areas, 4) state boundaries, and 5) local areas (allotments). Local areas were not considered in detail but the distribution of grazing costs and forage value for individual allotments were calculated. Sample size was limiting for evaluating ecological areas.

Similar to the findings of the 1966 grazing fee cost survey, we found variability within specific areas to be as large as the variability between areas. Grazing costs and forage value between states, economic areas, and ecological areas were not statistically different except in a few cases. There is no economic basis to regionalize grazing fees. This implies: 1) a uniform fee like that used in the past or 2) a competitive bid system that attempts to collect the market value of the forage at the allotment level. Continuing to use a uniform fee will overcharge some and undercharge others.

Method for Determining Forage Value and Estimating Grazing Fees

Each method considered for valuing public forage has limitations, and it is futile to apply any method in an attempt to derive an absolute value for public forage. A comparison to the private forage market has been used historically to estimate the value of public land forage, and we originally thought this method had the greatest potential for valuing public land grazing fee. This method requires the assumption that 1) ranchers are profit maximizers, 2) alternatives to public land grazing are available and 3) public and private leasing arrangements, terms, conditions and rangeland quality are comparable, or adjustments for these differences can be made. The results of this study led the GFTG to conclude that private forage comparison methods fail to meet at least one of these assumptions. There are obviously many factors in addition to profit that enter into the decision to use public and private land. The complementary value of public and private rangelands and the personal utility from ranching as a way of life are obvious examples.

Economists, appraisers and politicians have never been able to resolve the grazing fee issue, nor can they be expected to completely resolve the issue in the future. The complexity of the issue and the many factors involved in valuing public land grazing, especially the lack of a market for public land grazing, make it impossible to resolve. Without the benefits of such a market, current methods for valuing public land forage have many shortcomings, so much so that a defensible absolute value of public grazing cannot be determined. Thus, for the short-term, the GFTG recommends that no particular methodology be valued to establish forage value.

CHAPTER V

RECOMMENDATIONS

It is important to move forward on the grazing fee issue. The controversy surrounding the fee has disrupted the ranch real estate market, created uncertainty for ranchers, lenders and rural communities in the West, occupied an inordinate amount of time by policy makers and detracted from the management of public lands. A resolution of the grazing fee issue would lead to more stability within the livestock industry and dependent rural communities and would allow the BLM and USFS to concentrate on managing natural resources.

Given the variability of results in this study, the GFTG had difficulty making an absolute recommendation concerning the appropriate method for determining forage value for both land agencies and livestock types. Several of the methods examined produced comparable results for BLM cattle allotments, but inconsistent results for USFS and sheep allotments. The following recommendations deal with alternative forage valuation methods, pricing areas and ways of updating fees through time.

Method for Determining Forage Value and Estimating Grazing Fees

Each method examined for valuing public forage has limitations, and it is futile to apply any method in an attempt to derive an absolute value for public forage. A comparison to the private forage market has been used historically to estimate the value of public land forage, and we originally thought this method had the greatest potential for updating public land grazing fees. This method requires the assumption that 1) ranchers are profit maximizers, 2) alternatives to public land grazing are available and 3) public and private leasing arrangements, terms, conditions and rangeland quality are comparable, or adjustments for these differences can be made. The results of this study led the GFTG to conclude that private forage comparison methods fail to meet at least one of these assumptions. There are obviously many factors in addition to profit that enter into the decision to use public and private land. The complementary value of public and private resources and the personal utility from ranching as a way of life are obvious examples.

Economists, appraisers and politicians have never been able to resolve the grazing fee issue, nor can they be expected to completely resolve the issue in the future. A competitive market value is really the only way to reveal public land grazing values, especially on an allotment-by-allotment basis. Without the benefits of such a market, current methods for valuing public land forage have many inadequacies, so much so that a defensible absolute value of public grazing cannot be determined. Thus, for the short-run, the GFTG recommends that no particular methodology be utilized to establish forage value.

The GFTG concludes that when taken together, all of the methodologies examined suggest a market value for grazing public lands somewhere between \$3 and \$5/AUM. This range provides guidelines with which a grazing fee could be negotiated.

RECOMMENDATION: THE GRAZING FEE SHOULD BE ADMINISTRATIVELY OR LEGISLATIVELY DETERMINED WITHIN THE RANGE OF \$3 TO \$5/AUM.

This recommendation relies heavily upon the permit value approach. Permit value is the only estimate of value for grazing on public lands that is determined in a competitive market. The total cost approach results for cattle on BLM allotments are also within this range. Increasing grazing fees theoretically reallocates permit value (or some portion of permit value) to federal land agencies, with the implication that it belongs there. The fairness of this reallocation will be an obvious topic of discussion.

Pricing Areas

Our study results and the earlier 1966 grazing cost study indicate that there is no economic justification for setting different fees based on geographic or ecological boundaries. To reiterate what was stated nearly 25 years ago by Houseman et al. (1968, p. 2), and reinforced from our study results:

"Differences among ranching areas, as shown by the data, were not large enough in relation to the wide variation that existed within areas to provide a basis for recommending differential base fees among ranching areas."

RECOMMENDATION: ANY BASE FORAGE VALUE SHOULD BE APPLIED WESTWIDE.

Updating Grazing Fees

Evaluation of the PRIA indices revealed that the previous year's Forage Value Index (FVI) is the best predictor of private lease market changes. The BCPI and PPI have not helped explain short-term variation in forage value as originally envisioned. The FVI considers rancher's ability-to-pay because expected beef prices and production costs influence private lease rates when lessees and lessors negotiate a lease price.

RECOMMENDATION: ANY BASE GRAZING VALUE SHOULD BE UPDATED ANNUALLY WITH THE FORAGE VALUE INDEX.

A new base period will need to be set for the Forage Value Index. The period 1987 through 1991 is a recent 5-year period that could be used which includes values near the top and bottom of the beef price cycle.

The GFTG visualizes a grazing fee formula as follows:

$$(1) \quad \text{Fee}_t = \text{Base} \times \text{FVI}_{t-1}$$

Where:

Fee_t = grazing fee in the current year,

FVI_{t-1} = the Forage Value Index during the previous year with a base period of 1987-91,

Base = a politically negotiated rate between \$3 and \$5/AUM.

The GFTG also concurred with the suggestion made in the 1986 grazing fee study (USDA/USDI 1986) that the FVI be derived by weighting the individual state lease rates by the number of federal AUM's in the state rather than by the number of private lease observations, as is presently done. This would give a higher weighting to lease rates in those states with the most public lands. Adjustments in the weighting scheme would need to be made for those states that have an inadequate number of private leases from which a proper sample can be drawn.

Competitive Bidding

This study and others have documented that the value of grazing public lands varies greatly between allotments. The costs associated with each allotment as well as the benefits derived are unique. To determine the actual market value of grazing public lands, a competitive market is necessary. Creating a market for public land grazing through a competitive bid system may accomplish this objective. A competitive bid approach for valuing public grazing was suggested thirty years ago by Gardner (1963) and was proposed by the Office of Management and Budget in the 1980's. However, competitive bidding was not explored and tested in this study and would require substantial examination before a recommendation to implement a competitive bidding process could be made.

RECOMMENDATION: THE BLM AND USFS SHOULD INVESTIGATE THE POTENTIAL OF IMPLEMENTING A COMPETITIVE BID SYSTEM THAT WOULD CREATE A MARKET FOR PUBLIC LAND GRAZING.

Under a competitive bidding system, bids for public land forage would be based on site-specific allotments; thus, the need for pricing areas would be eliminated. The length of each lease would need to be determined, but if a reasonably short time frame were used, it would not be necessary to index or update grazing fees.

We recognize competitive bidding would require major changes in policy and that there are many problems that would have to be addressed. Some of the major concerns about a competitive bidding system include:

1. How to equitably reallocate value from current ranchers?
2. Should present permittees have the right to match the highest bid?
3. How to determine the terms and conditions of competitive leases? Specifically, items which will need to be addressed from a policy perspective include: duration of lease, provisions for minimum bids to cover administrative costs or handle small, scattered parcels, qualifying bidders, commensurate property requirements, common or group allotments, and control of range improvements by existing permit holders (eg. water rights).

Further evaluation of the competitive bid option may show that this method is politically unacceptable, that it will not be cost effective, or that it will not work for many small scattered land parcels.

Other Recommendations and Considerations

It should be recognized that the cost of government administration does not determine or influence the value of the forage for productive uses. Comparisons should be made between any forage valuation method and government administration costs to strive for administrative efficiency in the management process²².

We do not feel additional studies to define the apparent market value of forage by state or geographic area are justified. The results of the 1966 and 1992 grazing cost surveys demonstrate that little additional insight would be gained and that large variability will preclude further refinement of regionalized values.

RECOMMENDATION: ADDITIONAL STUDIES TO DEFINE THE MARKET VALUE OF PUBLIC LAND FORAGE USING MARKET PRICE COMPARISONS ARE NOT JUSTIFIED.

²²Some members of the Peer Review Committee and the GFTG felt that the cost of administration should be used to calculate a minimum grazing fee. If this were the case, a consistent procedure for determining the cost of administration would need to be developed on an AUM basis, involving a comparison of costs with and without livestock grazing.

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APPENDIX A: COST CALCULATIONS AND ASSUMPTIONS

Assumptions

Labor rates were determined through analysis of existing crop and livestock enterprise budgets, conversations of knowledgeable individuals within the test states and data reported in the grazing cost survey. Vehicle and equipment rates were determined from Wyoming and Colorado publications (Burgener and Hewlett 1993, Redmond et al. 1993). Horse use costs were determined through budget analysis of annual horse maintenance costs and included feed, shoeing, pasture and veterinary care. Livestock prices used to value death loss/disappearance were determined through analysis of regional livestock markets. Initial market projections were validated by project staff of the Western Livestock Marketing Information Project (Jim Robb, personal communication, Denver, CO 1993).

Labor

Owner/Management	\$8/hr
Unpaid family Labor	\$5.50/hr
Exchange Labor	\$5.50/hr
Hired Labor	as reported in the cost survey

Vehicles and Equipment

3/4 ton 4X4 Pickup	\$.37/mile
2X4 Pickup	\$.31/mile
Stock Trailer	\$.21/mile
2 Ton Truck	\$1.00/mile
Semi-Truck (livestock)	\$1.98/mile
ATV and Motorcycles	\$.25/mile
Sedan/Family Car	\$.28/mile
Caterpillar (D-8)	\$80/hour
Caterpillar (D-4)	\$40/hour
Small Tractor	\$5/hour
55 HP Tractor	\$10/hour
80 HP Tractor	\$13/hour
100 HP Tractor	\$18/hour
Road Grader	\$40/hour
Backhoe	\$40/hour
Airplane	\$70/hour
Horse Cost	\$715/year

Livestock Prices

Steer Calf	\$97/cwt
Heifer Calf	\$90/cwt

Yearling Steer	\$82/cwt
Yearling Heifer	\$78/cwt
Cow	\$700/head
Bull	\$1500/head
Lamb	\$58/cwt
Ewe	\$60/head
Ram	\$250/head

AU Conversion Factors

Livestock numbers and dates of use were used to calculate AUM's of use for each allotment or lease. In performing these calculations, the following Animal Unit (AU) conversion factors were used:

Cow	1.0 AU
Yearling	0.75 AU
Horse	1.25 AU
Bull	1.25 AU
Sheep	0.2 AU

Lease size was found to be the major factor affecting grazing costs because of this it was important to account for the influence of size in the analysis. This was done by weighting the mean calculations by the number of AUM's leased from the respective land agencies or from private lands. The result of the weighting was that each AUM leased was given equal importance in the analysis, versus using an unweighted mean which would give each lease an equal weighting without regard to size. Using a weighted statement in the general linear model (GLM) gives larger leases more weight relative to smaller ones and a weighted residual sum of squares is minimized (SAS Institute, Inc. 1985, p. 207). In addition to computing a weighted mean for all grazing cost considerations, four size classification means were defined as described above. This was the final cost analysis where the GLM model included interactions (adjusted for differences) between states, livestock type, land ownership type, and size of permit or lease. The sample size was not adequate to include sheep in the final comparison.

The least-squares means (LSM's) reported in the analysis are not the same as the weighted or simple averages for a particular classification of state, livestock type, land ownership type, or size. Rather, they are the value of class means that would be expected for a balanced design with respect to class variables and with all continuous variables held at their mean value (SAS Institute, Inc. 1985, p. 219). LSM's are estimated parameters from the linear statistical model.

Hypothesis Testing

Statistical differences between pricing costs were tested at the $\alpha = 0.10$ level using a t-test. The null hypothesis was that $LSM(i) = LSM(j)$. The LSM's, standard errors and t-values reported by the statistical model were used for the various tests.

APPENDIX B: STATISTICAL ANALYSES

The Statistical Model

The general linear model used in the analysis relies on the method of least squares to analyze data. Variation in the dependent variable (i.e., total grazing cost) is said to be due to differences in independent variables included in the model, with random error accounting for the remaining variation.

Various discrete (class) variables must be defined for the linear model. For this analysis, class variables were defined to be AREA (either state, eco-physiographic region or 1986 pricing area, depending on the regional analysis considered), LIVESTOCK type (cattle or sheep), land OWNERSHIP (BLM, USFS or private lease), and allotment SIZE classifications of AUM's on the grazing parcel ($S < 499$, $500 < S < 999$, $1000 < S < 2999$, $S > 3000$). Cross effects or interactions were also considered, including the interaction between AREA*OWNERSHIP, OWNERSHIP*LIVESTOCK, SIZE*OWNERSHIP, and SIZE*OWNERSHIP*LIVESTOCK.

Lease size was found to be the major factor influencing grazing costs; because of this it was important to account for the influence of size in the analysis. This was done by weighting the mean calculations by the number of AUM's leased from the respective land agencies or from private lands. The result of the weighting was that each AUM leased was given equal importance in the analysis, versus using an unweighted mean which would give each lease an equal weighting without regard to size. Using a weighted statement in the general linear model (GLM) gives larger leases more weight relative to smaller ones and a weighted residual sum of squares is minimized (SAS Institute, Inc. 1985, p. 207). In addition to computing a weighted mean for all grazing cost considerations, four size classifications were defined as described above. This was the final cost analysis where the GLM model included interactions (adjusted for differences) between states, livestock type, land ownership type, and size of permit or lease. The sample size was not adequate to include sheep in the final comparison.

The least-squares means (LSM's) reported in the analysis are not the same as the weighted or simple averages for a particular classification of state, livestock type, land ownership type, or size. Rather, they are the value of class means that would be expected for a balanced design with respect to class variables and with all continuous variables held at their mean value (SAS Institute, Inc. 1985, p. 235). LSM's are estimated parameters from the linear statistical model.

Hypothesis Testing

Statistical differences between grazing costs were tested at the $\alpha = 0.10$ level using a t-test. The null hypothesis was that $LSM(i) = LSM(j)$. The LSMs, standard errors and t-values reported by the statistical model were used for the various tests.

Forage value for public lands was estimated as the difference between total private land grazing costs (including the private lease rate) and total public land grazing costs (excluding the grazing fee). Statistical differences in these calculated values were tested using the contrast option available with the GLM procedure. To use the SAS contrast option for hypothesis testing, an L vector or matrix is defined for testing the hypothesis $L\beta = 0$ (SAS Institute, Inc. 1985, p. 192). Consider, as an example, the state level grazing cost analysis where LSM's for total grazing costs were estimated for each of the 3 states, for BLM, USFS and private land, and for cattle and sheep. This should result in 18 different means but no sheep producers grazing USFS land were included in the survey for New Mexico, thus only 17 means were computed. The LSMs (β 's) were arranged as follows:

β_1 = LSM for Idaho-BLM-cattle	β_{10} = LSM for New Mexico-private-sheep
β_2 = LSM for Idaho-BLM-sheep	β_{11} = LSM for New Mexico-USFS-cattle
β_3 = LSM for Idaho-private-cattle	β_{12} = LSM for Wyoming-BLM-cattle
β_4 = LSM for Idaho-private-sheep	β_{13} = LSM for Wyoming-BLM-sheep
β_5 = LSM for Idaho-USFS-cattle	β_{14} = LSM for Wyoming-private-cattle
β_6 = LSM for Idaho-USFS-sheep	β_{15} = LSM for Wyoming-private-sheep
β_7 = LSM for New Mexico-BLM-cattle	β_{16} = LSM for Wyoming-USFS-cattle
β_8 = LSM for New Mexico-BLM-sheep	β_{17} = LSM for Wyoming-USFS-sheep
β_9 = LSM for New Mexico-private-cattle	

To test the hypothesis that the forage value for cattle producers in Idaho and New Mexico are equal is equivalent to testing whether $(\beta_3 - \beta_1) - (\beta_9 - \beta_7) = 0$. After multiplying and rearranging terms it can be seen that the appropriate contrast is

$$L\beta = (-1 \ 0 \ 1 \ 0 \ 0 \ 0 \ 1 \ 0 \ -1 \ 0 \ 0 \ 0 \ 0 \ 0 \ 0 \ 0 \ 0) \begin{bmatrix} \beta_1 \\ \vdots \\ \beta_{17} \end{bmatrix}.$$

Similar contrasts were constructed for other hypotheses tested.

In addition to statistical tests to evaluate whether grazing costs and forage value were different by area and for different livestock classes, forage value estimates determined for each of the three test states were compared to forage value estimates derived by indexing forage value estimates from the 1966 grazing fee survey (USDA/USDI 1977) to 1992 levels. This was done by computing 90% confidence limits of forage value. If the confidence interval included the indexed forage value estimate then the two estimates of value were determined not to be statistically different.

Because forage value is estimated as the difference between two means, computing confidence limits required that a pooled variance be used. This was done following standard statistical procedures summarized by Hoshmand (1988, p.161). The equations used to compute confidence limits were:

$$S_p = \sqrt{\frac{(n_1 - 1)S_1^2 + (n_2 - 1)S_2^2}{n_1 + n_2 - 2}} \quad (1)$$

$$SE_p = S_p \sqrt{\frac{1}{n_1} + \frac{1}{n_2}} \quad (2)$$

$$CL = \bar{X} \pm t SE_p \quad (3)$$

Where:

S_p = pooled standard deviation,

n_i = sample size for mean i ,

S_i^2 = standard deviation associated with mean i ,

SE_p = pooled standard error,

CL = upper and lower 90% confidence limits,

\bar{X} = estimated mean value,

t = t-value for the desired 90% level of confidence and for the appropriate sample size given by $(n_1 + n_2 - 2)$.

Hansen design value is estimated as the difference between two random properties confidence limits required that a pooled variance be used. This was done following standard statistical procedures recommended by Hoenes and (1981). The equations used to compute confidence limits were:

$$Z_p = \frac{(n_1 - 1)S_1^2 + (n_2 - 1)S_2^2}{n_1 + n_2 - 2} \quad (1)$$

$$SE_p = \sqrt{\frac{1}{n_1} + \frac{1}{n_2}} \quad (2)$$

$$CI = \bar{Y} \pm 1.96 SE_p \quad (3)$$

- Where:
- SE_p = pooled standard deviation
 - n_i = sample size for mean i
 - S_i^2 = standard deviation associated with mean i
 - SE_p = pooled standard error
 - CI = upper and lower 95% confidence limits
 - \bar{Y} = estimated mean value
 - t = t -value for the desired 95% level of confidence and for the appropriate sample size
 - Given by $(n_1 + n_2 - 2)$

APPENDIX C: SUPPLEMENTARY RESULTS

Grazing Costs

This appendix gives a detailed listing of grazing costs estimated in Idaho, New Mexico and Wyoming. Grazing costs are first presented with averages combined across all three test states (Table C-1) and then separately (Tables C-2, C-3 and C-4). Means on the same row that are followed by the same letter are not statistically different at the $\alpha = 0.10$ level. The number in parenthesis is the standard error of the mean. Individual costs may not add to the total cost because the average for each cost item was estimated using an independent linear statistical model and is not the simple average for the cost category. Total labor and vehicle mileage expenses shown at the bottom of each table are also included in various categories listed elsewhere in the table.

A sensitivity analysis for selected model parameters is also presented (Tables C-6 through C-9) along with tables that present updated 1992 values of the 1966 study (Tables C-10 through C-12). Tables C-13, C-14 and C-15 contain lease information used in the market rental appraisal.

Subsidized feed	1.41 ^a (0.27)	1.17 ^a (0.24)	1.26 ^a (0.25)	1.31 ^a (0.27)	1.07 ^a (0.22)	1.33 ^a (0.32)
Water	6.37 ^a (0.77)	6.24 ^a (0.67)	6.17 ^a (0.67)	6.14 ^a (0.70)	6.32 ^a (0.72)	6.14 ^a (0.72)
Hay	6.22 ^a (0.77)	6.43 ^a (0.69)	6.12 ^a (0.65)	6.14 ^a (0.67)	6.18 ^a (0.69)	6.23 ^a (0.69)
Supplemental supplements	1.20 ^a (0.29)	1.41 ^a (0.27)	1.41 ^a (0.28)	1.33 ^a (0.25)	1.25 ^a (0.26)	1.24 ^a (0.25)
Overhead expenses						
Fenced land	6.37 ^a (0.77)	6.34 ^a (0.67)	6.07 ^a (0.63)	6.14 ^a (0.70)	6.32 ^a (0.72)	6.14 ^a (0.72)
Fence line	6.16 ^a (0.75)	6.07 ^a (0.66)	6.07 ^a (0.66)	6.17 ^a (0.71)	6.02 ^a (0.73)	6.13 ^a (0.73)
Clear land	6.29 ^a (0.79)	6.35 ^a (0.71)	6.11 ^a (0.62)	6.01 ^a (0.70)	6.25 ^a (0.70)	6.10 ^a (0.70)
Fence land and water	-	-	1.74 ^a (0.24)	-	-	1.38 ^a (0.27)
Total cost	19.41 ^a (0.79)	21.65 ^a (0.70)	21.06 ^a (0.68)	21.37 ^a (0.73)	21.08 ^a (0.73)	21.27 ^a (0.76)
Other Cost Categories						
Total labor	4.44 ^a (0.47)	4.44 ^a (0.39)	4.20 ^a (0.40)	4.44 ^a (0.40)	4.54 ^a (0.42)	4.33 ^a (0.35)
Total vehicle mileage	2.12 ^a (0.29)	2.16 ^a (0.27)	2.17 ^a (0.28)	2.24 ^a (0.29)	2.22 ^a (0.31)	2.24 ^a (0.31)

Table C-1. Average grazing costs on BLM, USFS, and private leased lands in Idaho, New Mexico and Wyoming combined (adjusted for differences in lease size), 1992.

	Cattle			Sheep		
	BLM	USFS	Private	BLM	USFS	Private
Sample size (n)	141	60	134	32	12	15
Lost animals	3.09 ^a (0.31)	4.49 ^b (0.41)	2.10 ^c (0.28)	5.16 ^b (0.69)	6.05 ^b (0.95)	2.63 ^{a,c} (0.87)
Association fees	0.20 ^a (0.08)	1.07 ^c (0.10)	0.01 ^b (0.07)	0.17 ^a (0.17)	0.00 ^b (0.24)	0.00 ^{a,b} (0.22)
Veterinary	0.08 ^a (0.03)	0.12 ^a (0.04)	0.12 ^a (0.03)	0.16 ^a (0.07)	0.37 ^b (0.10)	0.20 ^a (0.09)
Moving livestock	2.61 ^a (0.29)	4.49 ^b (0.38)	1.93 ^c (0.26)	3.97 ^b (0.64)	5.97 ^d (0.88)	2.51 ^{a,b,c} (0.81)
Herding	3.63 ^a (0.37)	5.00 ^c (0.49)	2.94 ^a (0.33)	7.30 ^b (0.83)	13.49 ^d (1.13)	3.05 ^a (1.04)
Misc. labor and mileage	0.61 ^a (0.08)	0.77 ^a (0.10)	0.18 ^b (0.07)	0.73 ^a (0.17)	1.13 ^c (0.23)	0.34 ^{a,b} (0.21)
Salt and feed	1.41 ^a (0.27)	1.12 ^a (0.36)	1.80 ^a (0.24)	1.81 ^a (0.60)	1.06 ^a (0.82)	1.53 ^a (0.75)
Water	0.47 ^a (0.07)	0.24 ^b (0.09)	0.11 ^b (0.06)	0.51 ^{a,b} (0.16)	0.38 ^a (0.22)	0.16 ^{a,b} (0.20)
Horse	0.22 ^a (0.03)	0.45 ^b (0.04)	0.15 ^a (0.03)	0.34 ^a (0.07)	0.78 ^c (0.10)	0.22 ^a (0.09)
Improvement maintenance	2.86 ^a (0.29)	3.41 ^a (0.37)	1.84 ^b (0.25)	2.33 ^{a,b} (0.63)	2.26 ^{a,b} (0.86)	2.22 ^{a,b} (0.79)
Development depreciation						
Federal land	0.30 ^a (0.03)	0.39 ^d (0.04)	0.00 ^c (0.03)	0.14 ^b (0.07)	0.24 ^{a,b,d} (0.10)	0.02 ^{b,c} (0.09)
Private land	0.16 ^a (0.05)	0.07 ^a (0.06)	0.15 ^a (0.04)	0.11 ^a (0.11)	0.02 ^a (0.15)	0.22 ^a (0.13)
Other costs	0.23 ^a (0.09)	0.50 ^c (0.11)	0.11 ^a (0.08)	1.01 ^b (0.19)	1.89 ^d (0.26)	0.35 ^a (0.24)
Private land lease rate	—	—	7.71 ^a (0.34)	—	—	7.18 ^a (1.07)
Total cost	15.41 ^a (0.99)	21.89 ^b (1.30)	19.04 ^c (0.88)	23.23 ^b (2.19)	32.68 ^d (3.00)	20.46 ^b (2.74)
Other Cost Categories						
Total labor	6.46 ^a (0.45)	9.47 ^b (0.59)	3.80 ^c (0.40)	9.47 ^b (1.00)	17.34 ^d (1.37)	5.53 ^{a,c} (1.25)
Total vehicle mileage	2.15 ^a (0.25)	3.16 ^b (0.33)	2.12 ^a (0.23)	3.29 ^b (0.56)	3.63 ^b (0.77)	1.54 ^a (0.70)

Table C-2. Average grazing costs on BLM, USFS, and private leased lands in Idaho (not adjusted for differences in lease size), 1992.

	Cattle			Sheep		
	BLM	USFS	Private	BLM	USFS	Private
Sample size (n)	43	23	46	11	8	3
Lost animals	2.69 ^{a,d} (0.39)	5.00 ^b (0.73)	1.90 ^a (0.56)	4.47 ^b (0.97)	7.28 ^c (0.84)	4.05 ^{b,d} (1.03)
Association fees	0.23 ^a (0.10)	1.97 ^b (0.19)	0.03 ^a (0.14)	0.48 ^a (0.25)	0.00 ^a (0.21)	0.00 ^a (0.26)
Veterinary	0.08 ^a (0.04)	0.04 ^a (0.08)	0.12 ^{a,b} (0.06)	0.28 ^b (0.10)	0.26 ^b (0.08)	0.10 ^{a,b} (0.11)
Moving livestock	2.08 ^a (0.36)	4.56 ^b (0.68)	1.99 ^a (0.52)	8.48 ^c (0.90)	2.90 ^a (0.77)	5.73 ^b (0.96)
Herdng	2.73 ^a (0.48)	4.78 ^b (0.91)	1.76 ^a (0.70)	9.90 ^c (1.21)	13.36 ^d (1.03)	3.11 ^{a,b} (1.29)
Misc. labor and mileage	0.81 ^a (0.09)	0.72 ^a (0.18)	0.17 ^b (0.13)	0.75 ^a (0.23)	1.25 ^c (0.20)	0.46 ^{a,b} (0.25)
Salt and feed	0.69 ^a (0.34)	0.16 ^a (0.64)	1.03 ^a (0.49)	2.77 ^b (0.85)	0.32 ^a (0.73)	0.14 ^a (0.90)
Water	0.26 ^a (0.09)	0.17 ^a (0.16)	0.05 ^a (0.12)	1.05 ^b (0.22)	0.42 ^a (0.18)	0.03 ^a (0.23)
Horse	0.06 ^a (0.04)	0.22 ^c (0.08)	0.07 ^a (0.06)	0.51 ^b (0.10)	0.51 ^b (0.09)	0.32 ^{b,c} (0.11)
Improvement maintenance	2.36 ^a (0.35)	2.18 ^{a,b} (0.65)	0.95 ^b (0.50)	2.61 ^a (0.86)	0.82 ^b (0.74)	1.95 ^{a,b} (0.92)
Development depreciation						
Federal land	0.39 ^a (0.04)	0.31 ^a (0.08)	0.00 ^b (0.06)	0.06 ^b (0.10)	0.13 ^b (0.09)	0.01 ^b (0.11)
Private land	0.01 ^a (0.06)	0.03 ^a (0.11)	0.13 ^a (0.08)	0.03 ^a (0.15)	0.00 ^a (0.12)	0.11 ^a (0.16)
Other costs	0.42 ^a (0.11)	0.92 ^b (0.20)	0.24 ^a (0.16)	1.99 ^c (0.27)	1.82 ^c (0.23)	0.68 ^{a,b} (0.29)
Private land lease rate	—	—	8.70 ^a (0.67)	—	—	4.74 ^b (1.23)
Total cost	12.55 ^a (1.25)	20.88 ^b (2.36)	17.10 ^b (1.80)	32.32 ^c (3.12)	28.64 ^c (2.66)	21.40 ^b (3.32)
Other Cost Categories						
Total labor	5.49 ^a (0.61)	8.25 ^b (1.16)	2.80 ^c (0.89)	13.89 ^d (1.53)	15.15 ^d (1.31)	7.46 ^{a,b} (1.63)
Total vehicle mileage	1.44 ^a (0.31)	2.42 ^a (0.58)	1.21 ^a (0.44)	4.33 ^b (0.77)	2.44 ^a (0.66)	1.00 ^a (0.82)

Table C-3. Average grazing costs on BLM, USFS, and private leased lands in New Mexico (not adjusted for differences in lease size), 1992.

	Cattle			Sheep		
	BLM	USFS	Private	BLM	USFS	Private
Sample size (n)	39	21	44	6	0	3
Lost animals	2.48 ^a (0.42)	3.76 ^b (0.45)	2.03 ^{a,c} (0.25)	1.18 ^c (0.65)		1.16 ^c (0.67)
Association fees	0.00 ^a (0.10)	0.03 ^a (0.11)	0.00 ^a (0.06)	0.00 ^a (0.16)		0.00 ^a (0.17)
Veterinary	0.10 ^{a,b} (0.04)	0.15 ^a (0.05)	0.11 ^{a,b} (0.03)	0.01 ^b (0.07)		0.31 ^c (0.07)
Moving livestock	1.64 ^a (0.39)	3.78 ^b (0.42)	1.16 ^a (0.24)	1.30 ^a (0.60)		3.02 ^b (0.62)
Herdling	3.12 ^a (0.52)	5.11 ^b (0.56)	2.70 ^{a,c} (0.32)	1.52 ^c (0.81)		4.11 ^{a,b} (0.83)
Misc. labor and mileage	0.39 ^a (0.10)	1.04 ^b (0.11)	0.27 ^a (0.06)	0.50 ^a (0.16)		0.51 ^a (0.16)
Salt and feed	3.50 ^a (0.37)	3.14 ^{a,b} (0.39)	2.94 ^{a,b} (0.22)	2.57 ^{a,b} (0.57)		1.99 ^b (0.59)
Water	0.66 ^a (0.09)	0.59 ^{a,b} (0.10)	0.22 ^b (0.06)	0.12 ^b (0.14)		0.34 ^b (0.15)
Horse	0.22 ^{a,c} (0.04)	0.52 ^b (0.05)	0.25 ^a (0.03)	0.10 ^c (0.07)		0.13 ^{a,c} (0.07)
Improvement maintenance	4.02 ^a (0.37)	6.36 ^c (0.40)	3.05 ^b (0.23)	2.24 ^b (0.58)		3.11 ^{a,b} (0.60)
Development depreciation						
Federal land	0.17 ^a (0.04)	0.68 ^c (0.05)	0.00 ^b (0.03)	0.07 ^{a,b} (0.07)		0.09 ^{a,b} (0.07)
Private land	0.45 ^a (0.06)	0.17 ^{b,c} (0.07)	0.24 ^b (0.04)	0.04 ^c (0.10)		0.21 ^{b,c} (0.10)
Other costs	0.08 ^a (0.12)	0.05 ^a (0.13)	0.04 ^a (0.07)	0.08 ^a (0.18)		0.29 ^a (0.19)
Private land lease rate	—	—	6.88 ^a (0.30)	—		7.00 ^a (0.80)
Total cost	16.16 ^a (1.34)	24.81 ^c (1.44)	19.68 ^b (0.82)	9.59 ^d (2.09)		21.93 ^{b,c} (2.15)
Other Cost Categories						
Total labor	5.21 ^a (0.66)	10.02 ^b (0.71)	3.31 ^c (0.40)	2.95 ^c (1.02)		7.36 ^d (1.06)
Total vehicle mileage	2.70 ^{a,c} (0.33)	5.46 ^b (0.36)	2.93 ^a (0.20)	2.01 ^c (0.51)		2.63 ^{a,c} (0.53)

Table C-4. Average grazing costs on BLM, USFS, and private leased lands in Wyoming (not adjusted for differences in lease size), 1992.

	Cattle			Sheep		
	BLM	USFS	Private	BLM	USFS	Private
Sample size (n)	59	16	44	15	4	9
Lost animals	3.45 ^a (0.45)	4.50 ^{a,b} (0.75)	1.64 ^c (0.44)	5.32 ^b (0.73)	5.32 ^{a,b} (1.53)	2.74 ^{a,c} (0.93)
Association fees	0.00 ^a (0.11)	1.74 ^b (0.19)	0.00 ^a (0.11)	0.00 ^a (0.19)	0.00 ^a (0.39)	0.00 ^a (0.24)
Veterinary	0.04 ^a (0.05)	0.13 ^{a,b} (0.08)	0.09 ^{a,b} (0.04)	0.08 ^{a,b} (0.08)	0.35 ^b (0.16)	0.00 ^a (0.10)
Moving livestock	2.69 ^a (0.41)	3.87 ^a (0.70)	1.71 ^a (0.41)	1.72 ^a (0.68)	9.88 ^b (1.42)	0.90 ^a (0.87)
Herding	3.47 ^a (0.56)	2.71 ^a (0.94)	2.91 ^a (0.55)	4.78 ^{a,b} (0.91)	7.23 ^b (1.91)	2.11 ^a (1.16)
Misc. labor and mileage	0.35 ^a (0.11)	0.43 ^b (0.18)	0.07 ^b (0.11)	0.67 ^a (0.18)	0.27 ^{a,b} (0.37)	0.18 ^b (0.22)
Salt and feed	0.74 ^a (0.39)	0.13 ^a (0.66)	1.61 ^a (0.38)	1.95 ^a (0.64)	0.26 ^a (1.34)	1.75 ^a (0.82)
Water	0.23 ^a (0.10)	0.00 ^a (0.16)	0.08 ^a (0.10)	0.29 ^a (0.16)	0.00 ^a (0.34)	0.08 ^a (0.20)
Horse	0.19 ^a (0.05)	0.46 ^b (0.08)	0.10 ^a (0.05)	0.27 ^a (0.08)	0.74 ^b (0.16)	0.12 ^a (0.10)
Improvement maintenance	2.59 ^a (0.40)	0.83 ^b (0.67)	1.32 ^b (0.39)	1.29 ^b (0.65)	0.39 ^a (1.37)	0.75 ^b (0.83)
Development depreciation						
Federal land	0.06 ^a (0.05)	0.15 ^a (0.08)	0.00 ^a (0.05)	0.07 ^a (0.08)	0.33 ^a (0.17)	0.00 ^a (0.10)
Private land	0.10 ^a (0.07)	0.00 ^a (0.11)	0.03 ^a (0.07)	0.05 ^a (0.11)	0.00 ^a (0.23)	0.07 ^a (0.14)
Other costs	0.08 ^a (0.12)	0.13 ^a (0.21)	0.03 ^a (0.12)	0.15 ^a (0.20)	0.64 ^a (0.43)	0.00 ^a (0.26)
Private land lease rate	—	—	7.71 ^a (0.52)	—	—	9.30 ^a (1.12)
Total cost	13.76 ^a (1.44)	15.09 ^{a,b} (2.42)	17.22 ^{a,b} (1.41)	16.28 ^a (2.36)	25.40 ^b (4.94)	17.93 ^{a,b} (3.01)
Other cost categories						
Total labor	5.72 ^a (0.71)	6.22 ^{a,d} (1.19)	3.64 ^{b,c} (0.69)	5.71 ^{a,b} (1.16)	10.24 ^d (2.42)	2.18 ^c (1.48)
Total vehicle mileage	2.72 ^a (0.35)	1.07 ^b (0.60)	1.60 ^b (0.35)	2.24 ^{a,b} (0.58)	1.80 ^{a,b} (1.22)	1.17 ^b (0.74)

Table C-5. Comparison between 1966 and 1992 grazing costs by category.

Item	-----Private-----				-----Combined Public-----			
	1966	Percent	1992	Percent	1966	Percent	1992	Percent
Cattle								
Lost Animals	\$0.37	8.15	\$2.10	11.03	\$0.60	18.29	\$3.65	20.11
Assoc Fees	\$0.00	0.00	\$0.00	0.00	\$0.08	2.44	\$0.48	2.64
Veterinary	\$0.13	2.86	\$0.12	0.63	\$0.11	3.35	\$0.10	0.55
Moving Livestock	\$0.25	5.51	\$1.93	10.14	\$0.24	7.32	\$3.35	18.46
Herding	\$0.19	4.19	\$2.94	15.44	\$0.46	14.02	\$4.31	23.75
Misc. Labor & Mileage	\$0.25	5.51	\$0.18	0.95	\$0.32	9.76	\$0.69	3.80
Salt & Feed	\$0.83	18.28	\$1.80	9.45	\$0.56	17.07	\$1.29	7.11
Water	\$0.06	1.32	\$0.11	0.58	\$0.08	2.44	\$0.39	2.15
Horse	\$0.10	2.20	\$0.15	0.79	\$0.16	4.88	\$0.31	1.71
Improve. Maintenance	\$0.40	8.81	\$1.84	9.66	\$0.43	13.11	\$3.18	17.52
Dev. Depreciation	\$0.03	0.66	\$0.15	0.79	\$0.11	3.35	\$0.45	2.48
Other Cost	\$0.14	3.08	\$0.11	0.58	\$0.13	3.96	\$0.34	1.87
Private Lease	\$1.79	39.43	\$7.71	40.49	\$0.00	0.00	\$0.00	0.00
Total Cost	\$4.54		\$19.04		\$3.28		\$18.15	
Sheep								
Lost Animals	\$0.65	11.48	\$2.63	12.85	\$0.70	15.45	\$5.39	20.83
Assoc Fees	\$0.00	0.00	\$0.00	0.00	\$0.04	0.88	\$0.04	0.15
Veterinary	\$0.11	1.94	\$0.20	0.98	\$0.11	2.43	\$0.22	0.85
Moving Livestock	\$0.38	6.71	\$2.51	12.27	\$0.42	9.27	\$4.74	18.32
Herding	\$1.16	20.49	\$3.05	14.91	\$1.33	29.36	\$8.89	34.36
Misc. Labor & Mileage	\$0.43	7.60	\$0.34	1.66	\$0.49	10.82	\$0.77	2.98
Salt & Feed	\$0.45	7.95	\$1.53	7.48	\$0.55	12.14	\$1.62	6.26
Water	\$0.16	2.83	\$0.16	0.78	\$0.15	3.31	\$0.39	1.51
Horse	\$0.07	1.24	\$0.22	1.08	\$0.16	3.53	\$0.47	1.82
Improve. Maintenance	\$0.24	4.24	\$2.22	10.85	\$0.20	4.42	\$2.12	8.19
Dev. Depreciation	\$0.02	0.35	\$0.24	1.17	\$0.09	1.99	\$0.26	1.01
Other Cost	\$0.22	3.89	\$0.35	1.71	\$0.29	6.40	\$1.36	5.26
Private Lease	\$1.77	31.27	\$7.18	35.09	\$0.00	0.00	\$0.00	0.00
Total Cost	\$5.66		20.46		\$4.53		\$25.87	

Note: 1966 grazing costs are from USDA/USDI (1977, P. 2-22) and 1982 costs are from Table III-1.

Sensitivity Analysis

Labor, vehicle charges and death loss have been shown to be the most significant nonfee costs between public and private leases. To examine the extent of any bias that may have occurred because of the assumptions made concerning wage and vehicle rates and the value of lost animals, sensitivity analysis was performed. This sensitivity analysis was only performed for cattle operations because of limited sample size for sheep operations at the state level.

Wage Rate Assumptions

Labor associated with each lease or allotment was segregated into four different categories. The first was labor and management duties performed by the owner, the second unsalaried family labor, the third exchange labor and the fourth hired labor. In this study, hired labor was assigned the wage rate that was paid by the rancher, along with the value of any perquisites such as housing and social security payments. Because owner, family, and exchange labor were not paid an established wage by the ranching operation, an assumed wage rate of \$8.50 for the owner and \$5.50 for family and exchange labor was assigned. This was based on average rates used in livestock budgets in western states (Torell and Word 1993). These wage rates provide a return for the opportunity costs associated with the time invested for these labor categories because hours worked on the ranch represent potential wage income foregone.

Though not theoretically sound from an economic standpoint, it has been argued by some that a return should not be assigned to "unsalaried" labor categories. To examine the effect wage rates have on the implied forage value, a zero wage rate was assigned to the owner's labor and management time, to the unsalaried family labor and to exchange labor. Providing no return for unsalaried labor will increase the implied value of forage if more unsalaried labor is used for public leases compared to private leases and will decrease the implied value of forage if the opposite occurs. Forage value will remain unchanged if identical labor input is required on private and public lands.

When a zero return was assigned to all unsalaried labor, the implied value of forage was increased for all cattle leases (Table C-6), except for BLM leases in Idaho. The greatest increase in implied forage value came from USFS permits because of the larger amounts of labor involved with most USFS permits. This was especially true in New Mexico because of the year-round nature of most permits and the cultural differences identified in Chapter III. The decrease in the implied forage value on BLM permits in Idaho resulted because more unsalaried labor was associated with private than BLM leases.

The value assigned specifically to the owners for their labor and managerial efforts was also evaluated. The average wage rate paid on ranches that had salaried full-time managers was \$10.58 per hour (based upon a 52-hour work week). To examine the sensitivity of the implied forage value to the wage rate assigned to the owner, the assumed \$8.50 rate was changed to \$10.50 per hour and then to \$5.50 per hour.

The results from changing the owner's wage rate were symmetrical (i.e., the absolute value of the change was the same regardless of the direction of change), with little impact on the implied value of the forage (Table C-7). The direction of change in forage value varied depending on the relative time the manager time spent on private leases compared to public leases. For BLM and USFS permits in Wyoming and for BLM permits in Idaho, a decrease (increase) in the owner's wage rate decreased (increased) the implied value of the forage. The opposite was true for BLM and USFS permits in New Mexico and for USFS permits in Idaho.

Livestock Price Assumptions

Livestock prices were utilized in this study to assign a value to the death loss occurring on leases and allotments. As livestock prices increase, the value of the death loss will increase and the implied value of the forage on public lands will decrease, assuming death loss is greater on public allotments compared to private leases. A decrease in the value of livestock would likewise increase the implied value of public forage given that death loss is greater on public lands.

To examine the sensitivity of forage value to changes in livestock value, the implied value of forage was examined by increasing and decreasing livestock prices by 15 percent (Table C-8). These changes in livestock prices closely match the range in livestock prices that have occurred during the past five years.

As with the owner's wage rate, the effect of changing the value of lost animals was symmetrical with respect to the direction of the change. The direction of the change was the same for all states, regardless of the type of federal permit. A decrease (increase) in cattle prices decreased (increased) the value of lost animals which in turn increased (decreased) the value of forage on public lands. The magnitude of the change in forage value ranged from a \$0.12 change for BLM permits in Idaho to \$0.47 for USFS permits in Idaho.

Vehicle Rates

While some ranchers utilize specialty vehicles and machines to perform various tasks, all ranching operations in our study utilized pickup trucks and stock trailers for livestock care and allotment maintenance. The fragility of the implied value of forage on public lands to the rates assigned pickup trucks and stock trailers was examined by both increasing and decreasing the rates charged for the use of these vehicles by 15 percent (Table C-9).

Changing the vehicle rate assumptions had little effect on the implied value of public forage. The implied value of forage for BLM leases in Idaho and USFS permits in Wyoming showed practically no change as the vehicle rates were increased or decreased. The largest change in the implied value of forage was \$0.40/AUM. The general direction

of change in the implied forage value was to decrease (increase) the implied value of forage on federal lands when the vehicle rate was increased (decreased).

Table C-6. Effect of a \$0.00 return to unsalaried labor on the implied value of forage for cattle operations.

		Baseline Wage Rates ¹		Return to All Unsalariated Labor and Management ² = \$0.00/hr	
		Total Cost ³ \$/AUM	Implied Forage Value ³ \$/AUM	Total Cost \$/AUM	Implied Forage Value \$/AUM
Idaho	BLM	12.55 (1.25)	4.55	11.13 (1.07)	4.35
	USFS	20.88 (2.36)	-3.78	16.93 (2.01)	-1.45
	Private	17.10 (1.80)	--	15.48 (1.54)	--
New Mexico	BLM	16.16 (1.34)	3.52	12.40 (1.41)	4.76
	USFS	24.81 (2.15)	-5.13	17.88 (1.23)	-0.72
	Private	19.68 (0.82)	--	17.16 (0.70)	--
Wyoming	BLM	13.76 (1.44)	3.46	10.74 (1.22)	3.49
	USFS	15.09 (2.42)	2.13	11.65 (2.06)	2.58
	Private	17.22 (1.41)	--	14.23 (1.20)	--

¹Baseline wage rates were \$5.50 for family and exchange labor, and \$8.50 for owner labor and management.

²Unsalariated labor included family labor, exchange labor, and owner labor and management.

³From Table III-4.

Table C-7. Effect of varying return rates to owner labor and management on the implied value of forage for cattle operations.

State	Baseline Wage Rates ¹		Return to Owner Labor and Management = \$10.50		Return to Owner Labor and Management = \$5.50	
	Total Cost ² \$/AUM	Implied Forage ² Value \$/AUM	Total Cost \$/AUM	Implied Forage Value \$/AUM	Total Cost \$/AUM	Implied Forage Value \$/AUM
Idaho						
BLM	12.55 (1.25)	4.55	12.89 (1.31)	4.59	12.22 (1.20)	4.51
USFS	20.88 (2.36)	-3.78	21.62 (2.48)	-4.14	20.15 (2.67)	-3.42
Private	17.10 (1.80)	—	17.48 (1.89)	—	16.73 (1.73)	—
New Mexico						
BLM	16.16 (1.34)	3.52	16.90 (1.41)	3.22	15.42 (1.29)	3.81
USFS	24.81 (2.15)	-5.13	26.28 (1.51)	-6.16	23.35 (1.38)	-4.12
Private	19.68 (0.82)	—	20.12 (0.86)	—	19.23 (0.79)	—
Wyoming						
BLM	13.76 (1.44)	3.46	14.40 (1.51)	3.47	13.12 (1.38)	3.45
USFS	15.09 (2.42)	2.13	15.69 (2.54)	2.18	14.48 (2.32)	2.09
Private	17.22 (1.41)	—	17.87 (1.48)	—	16.57 (1.36)	—

¹Baseline wage rate for owner labor and management was \$8.50.

²From Table III-4.

Table C-8. Effect of varying livestock prices on the implied value of forage for cattle operations.¹

State	Baseline Cattle Prices		Cattle Prices Increased by 15%		Cattle Prices Decreased by 15%	
	Total Cost ² \$/AUM	Implied Forage Value ² \$/AUM	Total Cost \$/AUM	Implied Forage Value \$/AUM	Total Cost \$/AUM	Implied Forage Value \$/AUM
Idaho						
BLM	12.55 (1.25)	4.55	12.96 (1.29)	4.43	12.15 (1.21)	4.67
USFS	20.88 (2.36)	-3.78	21.64 (2.44)	-4.25	20.13 (2.29)	-3.31
Private	17.10 (1.80)	--	17.39 (1.86)	--	16.82 (1.77)	--
New Mexico						
BLM	16.16 (1.34)	3.52	16.53 (1.38)	3.45	15.79 (1.30)	3.58
USFS	24.81 (2.15)	-5.13	25.38 (1.49)	-5.40	24.25 (1.40)	-4.88
Private	19.68 (0.82)	--	19.98 (0.85)	--	19.37 (0.79)	--
Wyoming						
BLM	13.76 (1.44)	3.46	14.28 (1.48)	3.19	13.24 (1.39)	3.74
USFS	15.09 (2.42)	2.13	15.77 (2.50)	1.70	14.41 (2.35)	2.57
Private	17.22 (1.41)	--	17.47 (1.46)	--	16.98 (1.37)	--

¹Assumed livestock prices:

Livestock Class	Baseline	Increase 15%	Decrease 15%
Steer calves (\$/lb)	0.97	1.12	0.82
Heifer calves (\$/lb)	0.90	1.04	0.77
Yearling steers (\$/lb)	0.82	0.94	0.70
Yearling heifers (\$/lb)	0.78	0.90	0.66
Cows (\$/hd)	700.00	805.00	595.00
Bulls (\$/hd)	1500.00	1725.00	1275.00

²From Table III-4.

Table C-9. Effect of varying vehicle rates on the implied value of forage for cattle operations.¹

State	Baseline Vehicle Rates		Vehicle Rate Increased by 15%		Vehicle Rates Decreased by 15%	
	Total Cost ² \$/AUM	Implied Forage Value ² \$/AUM	Total Cost \$/AUM	Implied Forage Value \$/AUM	Total Cost \$/AUM	Implied Forage Value \$/AUM
Idaho						
BLM	12.55 (1.25)	4.55	12.70 (1.27)	4.55	12.41 (1.23)	4.55
USFS	20.88 (2.36)	-3.78	21.18 (2.41)	-3.93	20.59 (2.32)	-3.63
Private	17.10 (1.80)	—	17.25 (1.84)	—	16.96 (1.77)	—
New Mexico						
BLM	16.16 (1.34)	3.52	16.49 (1.37)	3.46	15.83 (1.32)	3.57
USFS	24.81 (2.15)	-5.13	25.48 (1.47)	-5.52	24.14 (1.42)	-4.74
Private	19.68 (0.82)	—	19.95 (0.83)	—	19.40 (0.80)	—
Wyoming						
BLM	13.76 (1.44)	3.46	14.06 (1.46)	3.31	13.46 (1.41)	3.62
USFS	15.09 (2.42)	2.13	15.23 (2.47)	2.14	14.95 (2.38)	2.13
Private	17.22 (1.41)	—	17.37 (1.44)	—	17.08 (1.39)	—

¹Assumed vehicle rates per mile:

Vehicle	Baseline	Increase 15%	Decrease 15%
4X4 Pickup (\$/mi)	0.37	0.43	0.31
2X4 Pickup (\$/mi)	0.31	0.36	0.26
Stock trailer (\$/mi)	0.21	0.24	0.18

²From Table III-4.

Table C-10. Summary of public and private costs per AUM for grazing in the western states updated using the Input Cost Index (ICI) and the Forage Value Index (FVI), 1992.

Cost Item	Cattle		Sheep	
	Public Costs	Private Costs	Public Costs	Private Costs
Lost Animals	1.74	1.07	2.03	1.88
Assoc Fees	0.23	—	0.12	—
Veterinary	0.32	0.38	0.32	0.32
Moving Livestock	0.70	0.72	1.22	1.10
Herdng	1.33	0.55	3.86	3.36
Salt & Feed	1.62	2.41	1.59	1.31
Travel	0.93	0.72	1.42	1.25
Water	0.23	0.17	0.44	0.46
Horse	0.46	0.29	0.46	0.20
Fence Maintenance	0.70	0.73	0.26	0.44
Water Maintenance	0.55	0.44	0.32	0.26
Dev Depreciation	0.32	0.09	0.26	0.06
Other	0.38	0.41	0.84	0.64
Total Non-Fee	9.51	7.98	13.14	11.28
Private Lease Rate ¹	—	4.92	—	4.87
Total Cost	9.51	12.90	13.14	16.15
Forage Value	3.39		3.01	
Combined Cattle & Sheep (Weighted Average: Cattle 88%, Sheep 12%)		3.34		

¹Updated using the FVI computed for the 16 western states. Other categories use the ICI. Indexing procedure is described in USDA/USDI (1992, pp. 57-58), but for the 1990 base year instead of 1992 shown here.

Table C-11. Summary of public and private costs per AUM for grazing in the western states for the base years 1990-1992, updated using the Input Cost Index (ICI) and the Forage Value Index (FVI).

Cost Item	Cattle		Sheep	
	Public Costs	Private Costs	Public Costs	Private Costs
Lost Animals	1.73	1.07	2.02	1.88
Assoc Fees	0.23	--	0.12	--
Veterinary	0.32	0.39	0.32	0.32
Moving Livestock	0.69	0.72	1.21	1.10
Herding	1.33	0.55	3.84	3.35
Salt & Feed	1.62	2.40	1.59	1.30
Travel	0.93	0.72	1.42	1.24
Water	0.23	0.17	0.43	0.46
Horse	0.46	0.29	0.46	0.20
Fence Maintenance	0.69	0.72	0.26	0.43
Water Maintenance	0.55	0.43	0.32	0.06
Dev Depreciation	0.32	0.09	0.26	0.06
Other	0.38	0.40	0.84	0.64
Total Non-Fee	9.48	7.95	13.09	11.24
Private Lease Rate ¹	--	4.73	--	4.67
Total Cost	9.48	12.68	13.09	15.91
Forage Value	3.20		2.82	
Combined Cattle & Sheep (Weighted Average: Cattle 88%, Sheep 12%)		3.15		

¹Updated using the FVI computed for the 16 western states. Other categories use the ICI. Indexing procedure is described in USDA/USDI (1992, pp. 57-58), but for the 1990 base year instead of 1990-92 shown here.

Table C-12. Summary of public and private costs per AUM for grazing in the western states, updated using various cost indices reported by USDA, NASS (July 1992) and the Forage Value Index (FVI), 1992.

Cost Item	Cattle		Sheep	
	Public Costs	Private Costs	Public Costs	Private Costs
Lost Animals	1.77	1.09	2.07	1.92
Assoc Fees	0.28	—	0.14	—
Veterinary	0.53	0.62	0.53	0.53
Moving Livestock	1.31	1.36	2.29	2.07
Herding	2.20	0.91	6.37	5.56
Salt & Feed	2.26	3.35	2.22	1.81
Travel	1.63	1.28	2.50	2.19
Water	0.28	0.21	0.53	0.56
Horse	0.37	0.23	0.37	0.16
Fence Maintenance	0.99	1.03	0.37	0.62
Water Maintenance	0.78	0.62	0.45	0.37
Dev Depreciation	0.39	0.11	0.32	0.07
Other	0.46	0.49	1.02	0.77
Total Non-Fee	13.25	11.32	19.18	16.63
Private Lease Rate ¹	—	4.74	—	4.69
Total Cost	13.25	16.06	19.18	21.32
Forage Value	2.81		2.14	
Combined Cattle & Sheep (Weighted Average: Cattle 88%, Sheep 12%)		2.73		

¹Updated using the FVI computed for the 11 western states. The indexing procedure is described in USDA/USDI (1992, Exhibit A, Nielsen, pp. 1-6, but for the 1990 base year instead of 1992 shown here.

²Sheep and cattle are weighted in the same proportion as the 1966 grazing fee study.

Table C-13. Wyoming public land grazing lease (competitive or negotiated) used in the market rental appraisal.

[illegible]

Table C-14. Wyoming public land grazing leases (negotiated state subleases used in the market rental appraisal.

Lease Number	Date	Term of Lease	County*	Per Cent State Land	State AUM's	Total AUM's	Allowance for Lessee's Improvements	Net Value of Forage (\$/AUM)
1	01/89	4 Years	-	09%	277	3,000	10%	\$4.62
2	04/88	5 Years	-	26%	775	3,000	15%	\$8.51
3	04/88	5 Years	-	17%	416	2,400	15%	\$5.67
4	10/89	5 Years	-	13%	68	504	15%	\$10.54
5	05/92	9 Months	-	14%	171	1,200	10%	\$6.75
6	03/90	3 Years	-	26%	541	2,100	15%	\$6.07
7	03/90	3 Years	-	05%	254	4,680	15%	\$6.52
8	04/90	5 Years	-	26%	170	654	15%	\$6.25
9	01/90	5 Years	-	62%	818	1,310	0%	\$8.43
10	03/89	4 Years	-	05%	305	5,800	15%	\$4.56
11	04/87	5 Years	-	80%	222	276	10%	\$8.90
Weighted Average								\$7.06

* County can be obtained from lease files.

Table C-15. New Mexico public land leases (competitive or negotiated) used in the market rental appraisal.

LEASE NO.	DATE	TERM	COUNTY	% PUBLIC LAND	TOTAL AUMS	TOTAL COST TO LESSEE (\$/AUM)	LESSOR-PD. PUBLIC GRAZING FEE (\$/AUM)	LESSOR-PROVIDED SERVICES (\$/AUM)	NET VALUE OF FORAGE (\$/AUM)
1	01/89	3 Years	Eddy	94	564	\$7.11	—	\$1.52	\$5.59
2	01/86	5 Years	Luna	94	4,200	\$7.08	—	\$1.52	\$5.56
3	04/90	5 Years	Socorro	60	1,200	\$6.51	\$1.15	\$1.33	\$4.03
4	02/92	1 Year	Sierra	92	3,264	\$6.00	—	\$1.52	\$4.48
5	04/89	1 Year	Eddy	94	1,216	\$5.84	\$1.77	—	\$4.07
6	11/91	5 Years	Socorro	86	1,764	\$5.10	\$1.65	—	\$3.45
7	03/88	5 Years	Socorro	81	384	\$4.74	—	\$.35	\$4.39
8	01/91	3 Years	Eddy	86	262	\$3.52	—	—	\$3.52
Weighted Average									\$4.64
McGregor Range	10/92 & 11/92	1 Year *	Otero	100	26,579	\$4.80 (weighted)	—	\$1.96	\$2.84

* One Unit for 2 years and 1 Unit for 5 years; remainder for 5 years.

This evaluation is being conducted to determine whether it is necessary to increase the total costs of raising livestock on federal and private lands. The results of this information is to update the 1982 survey. The survey is being conducted by the University of Idaho, University of Wyoming, New Mexico State University and Colorado State University in cooperation with the Bureau of Land Management and U.S. Forest Service. It is believed that results from this evaluation will provide a valid comparison between private and public grazing costs to use in estimating grazing fees.

Your statement was randomly selected for this study. Be assured that any information you provide will be strictly confidential. Only summary results by state or region will be released.

Estimate _____

1. GENERAL RANCH DESCRIPTION

The following information is for the 1992 operating year. Please include accurate information for your desired land as well as your future allotments.

A. Name _____

Address _____

Phone _____

B. In what county is your ranch located? (County) _____

C. What was your average livestock inventory on January 1, 1992?

1. Horse _____ No. Regd. _____ No.
Held _____ No.

2. Yearling cattle inventory (over 6 months of age)

Owned Stock _____ No. Rented Stock _____ No.

Purchased Stock _____ No. Purchased calves _____ No.

3. Goat _____ No. Goat _____ No.

Yearling _____ No.

4. Sheep _____ No.

5. Other livestock (specify) _____

_____ No.

1992 Grazing Cost Evaluation
Federal Grazing Costs

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This evaluation is being conducted in selected western states to accurately determine the total costs of running livestock on federal and privately owned rangeland. The purpose of this information is to update the costs of federal and private grazing for western livestock producers. This survey is being conducted by the University of Idaho, University of Wyoming, New Mexico State University and Colorado State University in cooperation with the Bureau of Land Management and U.S. Forest Service. It is intended that results from this cost evaluation will provide a valid comparison between private and public grazing costs to use in evaluating grazing fees.

Your allotment was randomly selected for this study. Be assured that any information you provide will be strictly confidential. Only summary statistics by state or region will be released.

Enumerator _____

I. GENERAL RANCH DESCRIPTION

The following information is for the 1992 operating year. Please include accurate information for your deeded land as well as your federal allotments.

A. Name: _____

Address: _____

Phone: _____

B. In what county is your ranch headquarters located?

C. What was your average livestock inventory on January 1, 1992?

1. Mother cows _____ No. Repl. Heifers _____ No.

Bulls _____ No.

2. Yearling market livestock (Over 6 months of age)

Raised Steers _____ No. Raised Heifers _____ No.

Purchased Steers _____ No. Purchased Heifers _____ No.

3. Ewes _____ No. Rams _____ No.

Yearlings _____ No.

4. Horses _____ No.

5. Other livestock (specify) _____
_____ No.

II. LIST OF ALLOTMENTS

1. Are your allotments managed as separate units ☐ or as one large block of land ☐?
2. In this section, please provide a list of all federal allotments leased in 1992.

A. Allotment 1 _____

Allotment Number _____

Operator Number _____

Is this allotment a BLM ☐ or USFS allotment ☐?

Name of BLM resource area or Forest ranger district in which allotment is located:

B. Allotment 2 _____

Allotment Number _____

Operator Number _____

Is this allotment a BLM ☐ or USFS allotment ☐?

Name of BLM resource area or Forest ranger district in which allotment is located:

C. Allotment 3 _____

Allotment Number _____

Operator Number _____

Is this allotment a BLM ☐ or USFS allotment ☐?

Name of BLM resource area or Forest ranger district in which allotment is located:

D. Allotment 4 _____

Allotment Number _____

Operator Number _____

Is this allotment a BLM ☐ or USFS allotment ☐?

Name of BLM resource area or Forest ranger district in which allotment is located:

E. For any additional allotments please add another page like this one.

III. ALLOTMENT CHARACTERISTICS AND MANAGEMENT

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This section will be filled out for each allotment identified in Part I and used during 1992.

A. Allotment Name _____

Allotment Number _____

1. Is this an individual ☐ or common allotment ☐?
2. Is this allotment classified as Section 3 ☐ or Section 15 ☐ ?
3. Is this allotment categorized as M ☐, I ☐ or C ☐.
4. Total 1992 billed grazing use (AUMs) _____

(Estimate for remainder of 1992 if necessary).

5. Allotment Acreage and Ownership

Type of Ownership	Acreage	AUMS of Grazing
BLM		
U.S. Forest Service		
Other Federal		
State Trust Land		
Private		
Private Lease		
Uncontrolled		
Other (describe)		
TOTAL		

6. What type of vegetation is on this grazing allotment?

TYPE	
(1) Sagebrush	%
(2) Salt Desert Shrub (Atriplex, Greasewood)	%
(3) Chaparral (Oakbrush, Mt. Mahogany, Chamise)	%
(4) Creosote bush (Blackbrush, cactus, mesquite, etc.)	%
(5) Pinyon-Juniper	%
(6) Coniferous Forest Types (Ponderosa Pine, Lodgepole, etc.)	%
(7) Broadleaf Woodland (Aspen, Oaks, Cottonwood-River Bottom)	%
(8) Native Grassland	%
(9) Native Meadowland	%
(10) Seeded grasses	%
(11) Other*	%
*Describe	%

7. What were the number of livestock on this allotment in 1992?

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	On the Allotment		Off the Allotment	
	Number	Date	Number	Date
Total Cows (Include cows with calves and dry cows)				
Weaned Calves (Weaning age to 1 year old)				
Yearlings (1 to 2 years old, excluding cows listed above)				
Bulls				
Ewes				
Rams				
Weaned Lambs (weaning age to one year old)				
Wethers				
Horses (Include only horses under permit or license)				

8. What topographic features best describe this allotment? (give proportions)

Description

(1) Steep	%
(2) Steep and rocky	%
(3) Rolling Hills	%
(4) Gentle, Flat	%
(5) Other*	%

*Describe

9. How many pasture (units) are there in this allotment? (please check one)

☐ 1, ☐ 2, ☐ 3, ☐ 4, ☐ 5, ☐ 6 or more

10. How would you describe your current grazing management plan on this allotment? (Please check one)

☐ Scheduled rest rotation among a number of pastures (one or more pastures used each year)

How many pastures are used each year? _____

☐ Scheduled deferred rotation among a number of pastures.

How many pastures are used each year? _____

☐ Open rotation with scheduled moves.

How many pastures were used each year? _____

How many moves while in this lease? _____

☐ Continuous grazing, with all livestock distributed freely

☐ Decision deferment (i.e., non-scheduled moves, Savory)

☐ Other (specify) _____

11. How many years have you owned this permit ☐ or how long has the permit been in your family ☐ ?

_____ Years

12. What year was the permit purchased _____ and how much did you pay for it? _____ \$/AUM or \$/AUY (Indicate the unit).

IV. RANGE DEVELOPMENT AND MAINTENANCE COSTS

Include here all range improvements and developments that service the allotment or allow harvest of forage, regardless of land ownership. Include all improvements made after 1971.

A. Range Developments

		New Developments Since 1971									
Type of Development	Code	Description	Year Developed	Land Ownership (e.g. Federal, State, Private)	Number	Units	Total Improvement Cost (\$)	Dollars rancher Invested* (including hired labor)	Hours of unpaid labor including operator and other unpaid labor	Percent Improvement use on this allotment	Percent Improvement use for other purposes (e.g. irrigation)
Development	Code	(a)	(b)	(c)	(d)	(e)	(f)	(g)	(h)	(i)	(j)
Wells	01										
Spring	02										
Ponds	03										
Fence (Specify Type)	04										
Roads	05										
Corrals & Chutes	06										
Oilers	07										
Dipping Vats	08										
Seeding	09										
Spraying	10										
Windmills	11										
Brush Control	12										
Other (Specify in notes)	13										

*Exclude cost share payments or reimbursements refunded through cost share programs.

B. Range Improvement Maintenance

Maintenance Item	Cost
Water Maintenance	
(1) Water pumping costs (gas, electric, diesel, service)	125
(2) Contract expenses to haul water?	
(3) Materials to maintain and clean wells, stock ponds and springs?	
(4) Cost of bulldozers, backhoes, and other equipment used for water maintenance?	
(5) Other costs in maintaining stock ponds, wells and springs on the allotment?	
Fence Maintenance	
(5) What was the cost of Materials and equipment to maintain fences on the allotment during the last grazing season?	
Other Costs	
(6) Did you have any costs in implementing or maintaining improvements other than those we have talked for the 1992 grazing season? <u>Describe:</u>	

V. OTHER CASH COSTS

This section of the questionnaire will be used to list the cash costs expended in grazing livestock on this allotment.

- A. What were your cash expenditures for the following items that were used while livestock were on this allotment in 1992?

Description	Units	Dollars
(1) Salt		
(2) Veterinary and Medicine		
(3) Protein Supplements, Grain, Hay		
(4) Contracted Feed		
(6) Predator Control (Poisons, trappers)		
(7) Other items not previously mentioned		

Do association fees pay for: (check all that apply)

- ☐ Grazing Fees
 ☐ Herding, rider
☐ Salt and supplements
 ☐ Fence and improvement maintenance
☐ Other (specify _____)

B. Miscellaneous Costs

What were the cash and non-cash expenditures for the following items pertaining to this allotment during 1992? (Paperwork, stockmen's grazing meetings, vandalism, rounding up stray stock after gates are left open, meetings with federal personnel, etc.)

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	Transportation		Labor			
	Vehicle Type	Mileage	Manager Operated (hrs)	Family (hrs)	Regular Hired (hrs)	Day (hrs)
Paper work						
Meetings						
Vandalism						
Stray roundup						

VI. DEATH LOSSES

A.. What was the average 1992 livestock sale weights?

_____ Steer calves
 _____ Heifer calves
 _____ Yearling steers
 _____ Yearling heifers
 _____ Cull cows
 _____ Lambs
 _____ Cull Ewes
 _____ Cull bucks
 _____ Wool per ewe

B. How many livestock died or disappeared on this allotment in 1992?

Cows _____
 Yearling Steers _____ Yearling Heifers _____
 Steer Calves _____ Heifer Calves _____
 Bulls _____
 Rams _____ Ewes _____
 Lambs _____

VII. LABOR

This section of the questionnaire asks about the labor requirements (number of people and the hours required) to move livestock to allotment, to herd and distribute livestock on allotment, to gather and move livestock from allotment, to maintain the physical requirements of the allotment (fences, water tanks, dams, etc.) and the labor requirements for animal health and maintain (herd checking, doctoring, salting, feeding, watering, etc.).

127

	Pay Unit* (code)	Wage rate per unit time	Approx. monthly cost for social security, unempl. insurance, room and board and benefits.
Hired Manager			
Hired labor			
Day labor			

*Paid by: hour=1 day=2 week=3 month=4 unpaid=5 exchange=6

	Livestock to allotment (A)		Herding, distribution, grazing mgt. (B)		Maintain allotment (C)		Animal health and periodic inspection (D)		Gathering & moving livestock (E)	
	no.	hrs.	no.	hrs.	no.	hrs.	no.	hrs.	no.	hrs.
Yourself/manager										
Family members										
Regular hired labor										
Day Labor										
Exchange Labor										

VIII. TRANSPORTATION

This section of the questionnaire asks about the vehicle requirements to move livestock to allotment, vehicle requirements to herd and distribute livestock on allotment, gather and move livestock from allotment, maintain the physical requirement of the allotment (fences, water tanks, dams, etc.) and the vehicles requirements for animal health and maintenance (herd checking, doctoring, salting, feeding, watering, etc.).

(Please: use hours on farm and industrial equipment instead of miles)

This section of the questionnaire will ask about the transportation of livestock to and from the allotment.

A. What is the distance from your ranch headquarters to this allotment?

_____ miles

B. If livestock were not taken directly from the ranch headquarters, give the distance from the last lease, allotment or owned pasture used.

_____ miles

128

This section of the questionnaire will ask you about the horse requirements to operate and maintain this allotment.

129

A. Horse requirements to operate and maintain this allotment

Horse Requirements		
	Average number of horses used	Average days horses used
Livestock to allotment		
Livestock distribution/herding/ grazing management		
Livestock gathering		
Livestock off allotment		
Maintenance of allotment		
Animal health and maintenance		

B. What percent* of the total horse requirements were provided by the following:

- _____ % Owned horses
 _____ % Rented horses
 _____ % Horses provided by hired range riders
 _____ % Horses provided by friend or neighbor
 _____ % Other:(specify: _____)

* Sum should equal 100%

END (Thank You)

1992 Grazing Cost Evaluation
Private Grazing Leases

130

This evaluation is being conducted in selected western states to accurately determine the total costs of running livestock on federal and privately owned rangeland. The purpose of this information is to update the costs of federal and private grazing for western livestock producers. This cost evaluation is being conducted by the University of Idaho, University of Wyoming, New Mexico State University and Colorado State University in cooperation with the Bureau of Land Management and U.S. Forest Service. It is intended that results from this cost evaluation will provide a valid comparison between private and public grazing costs to use in evaluating grazing fees.

Your private lease was randomly selected for this study. Be assured that any information you provide will be strictly confidential. Only summary statistics by state or region will be released.

Enumerator _____

I. GENERAL RANCH DESCRIPTION

The following information is for the 1992 operating year. Please include accurate information for your deeded land as well as your private leases.

A. Name: _____

Address: _____

Phone: _____

B. In what county is your ranch headquarters located?

C. What was your average livestock inventory on January 1, 1992?

1. Mother cows _____ No. Repl. Heifers _____ No.
Bulls _____ No.

2. Yearling market livestock (Over 6 months of age)

Raised Steers _____ No. Raised Heifers _____ No.
Purchased Steers _____ No. Purchased Heifers _____ No.

3. Ewes _____ No. Rams _____ No.
Yearlings _____ No.

4. Horses _____ No.

5. Other livestock (specify) _____
_____ No.

II. LIST OF PRIVATE LEASES

1. Are your leases managed as separate units ☐ or as one large block of land ☐?
2. In this section, please provide a list of all private leases in 1992.

131

A. Lease 1 _____

Landlord Name _____

County _____

B. Lease 2 _____

Landlord Name _____

County _____

C. Lease 3 _____

Landlord Name _____

County _____

D. Lease 4 _____

Landlord Name _____

County _____

E. For any additional leases please add another page like this one.

III. Lease Arrangement

A. How were you charged for this lease and what was the lease rate?

- | | |
|--------------------------------------|----------------|
| a) _____ per acre | Rate: \$ _____ |
| b) _____ per head per month | Rate: \$ _____ |
| c) _____ per pound of gain | Rate: \$ _____ |
| d) _____ per cwt of gain | Rate: \$ _____ |
| e) _____ other (specify) _____ | Rate: \$ _____ |

B. What was the total dollar amount paid for this lease?

When was this grazing lease paid?

Beginning of grazing season ☐

After grazing season ☐

Other ☐ (describe) _____

C. Terms and Conditions of this lease.

- | | LESSOR | LESSEE |
|---|--------------------------|--------------------------|
| a) Maintenance of property | <input type="checkbox"/> | <input type="checkbox"/> |
| b) Liability insurance | <input type="checkbox"/> | <input type="checkbox"/> |
| c) Daily livestock care | <input type="checkbox"/> | <input type="checkbox"/> |
| d) Receiving and shipping livestock | <input type="checkbox"/> | <input type="checkbox"/> |
| e) Water supply | <input type="checkbox"/> | <input type="checkbox"/> |

☐

- f) Death loss adjustment ☐ ☐
 g) Livestock tax ☐ ☐
 h) Utilities ☐ ☐
 i) Other (specify) ☐ ☐

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D. What other rights, besides grazing, were associated with the lease?

Recreational _____ Wood harvesting _____ House _____
 Barns _____ Equipment _____ Other (specify) _____
 Crop Aftermath _____ Hay _____

IV. LEASE CHARACTERISTICS AND MANAGEMENT

This section will be filled out for each lease identified in Part II and used during 1992.

A. Lease Name _____

1. What were the turn-on and gathering dates for this lease in 1991?

Date on _____ Date off _____

2. How many acres are in this lease?

Acres _____

3. Of these total acres, how many acres are used for grazing.

Acres _____

4. What type of vegetation is on this grazing lease?

TYPE	
(1) Sagebrush	%
(2) Salt Desert Shrub (Atriplex, Greasewood)	%
(3) Chaparral (Oakbrush, Mt. Mahogany, Chamise)	%
(4) Creosote bush (Blackbrush, cactus, mesquite, etc.)	%
(5) Pinyon-Juniper	%
(6) Coniferous Forest Types (Ponderosa Pine, Lodgepole, etc.)	%
(7) Broadleaf Woodland (Aspen, Oaks, Cottonwood-River Bottom)	%
(8) Native Grassland	%
(9) Native Meadowland	%
(10) Seeded grasses	%
(11) Other*	%
*Describe	%

5. What were the number of livestock on this lease in 1992?

133

	On the Lease		Off the Lease	
	Number	Date	Number	Date
Total Cows (Include cows with calves and dry cows)				
Weaned Calves (Weaning age to 1 year old)				
Yearlings (1 to 2 years old, excluding cows listed above)				
Bulls				
Ewes				
Rams				
Weaned Lambs (weaning age to one year old)				
Wethers				
Horses				

6. What topographic features best describe this lease? (give proportions)

Description

(1) Steep	%
(2) Steep and rocky	%
(3) Rolling Hills	%
(4) Gentle, Flat	%
(5) Other*	%

*Describe

7. How many pasture (units) are there in this lease? (please check one)

☐ 1, ☐ 2, ☐ 3, ☐ 4, ☐ 5, ☐ 6 or more

134

8. How would you describe your current grazing management plan on this lease?
(Please check one)

☐ Scheduled rest rotation among a number of pastures (one or more pastures used each year)

How many pastures are used each year? _____

☐ Scheduled deferred rotation among a number of pastures.

How many pastures are used each year? _____

☐ Open rotation with scheduled moves.

How many pastures were used each year? _____

How many moves while in this lease? _____

☐ Continuous grazing, with all livestock distributed freely

☐ Decision deferment (i.e., non-scheduled moves, Savory)

☐ Other (specify) _____

9. How many years have you operated this lease ☐ or how long has the lease been in your family ☐ ?

_____ Years

10. What is the term of this lease?

V. RANGE DEVELOPMENT AND MAINTENANCE COSTS

Include here all range improvements and developments that service the lease or allow harvest of forage, regardless of land ownership. Include all improvements made after 1971.

A. Range Developments

		New Developments Since 1971									
Type of Development	Code	Description	Year Developed	Land Ownership (e.g. Federal, State, Private)	Number	Units	Total Improvement Cost (\$)	Dollars rancher Invested* (including hired labor)	Hours of unpaid labor including operator and other unpaid labor	Percent Improvement use on this lease	Percent Improvement use for other purposes (e.g. irrigation)
Development	Code	(a)	(b)	(c)	(d)	(e)	(f)	(g)	(h)	(i)	(j)
Wells	01										
Spring	02										
Ponds	03										
Fence (Specify Type)	04										
Roads	05										
Corrals & Chutes	06										
Oilers	07										
Dipping Vats	08										
Seeding	09										
Spraying	10										
Windmills	11										
Brush Control	12										
Other (Specify in notes)	13										

*Exclude cost share payments or reimbursements refunded through cost share programs.

B. Range Improvement Maintenance

Maintenance Item	Cost
Water Maintenance	
(1) Water pumping costs (gas, electric, diesel, service)	
(2) Contract expenses to haul water?	
(3) Materials to maintain and clean wells, stock ponds and springs?	
(4) Cost of bulldozers, backhoes, and other equipment used for water maintenance?	
(5) Other costs in maintaining stock ponds, wells and springs on the lease?	
Fence Maintenance	
(5) What was the cost of Materials and equipment to maintain fences on the lease during the last grazing season?	
Other Costs	
(6) Did you have any costs in implementing or maintaining improvements other than those we have talked for the 1992 grazing season?	
Describe:	

VI. OTHER CASH COSTS

This section of the questionnaire will be used to list the cash costs expended in grazing livestock on this lease.

- A. What were your cash expenditures for the following items that were used while livestock were on this lease in 1992?

Description	Units	Dollars
(1) Salt		
(2) Veterinary and Medicine		
(3) Protein Supplements, Grain, Hay		
(4) Contracted Feed		
(6) Predator Control (Poisons, trappers)		
(7) Other items not previously mentioned		

What were the cash and non-cash expenditures for the following items pertaining to this lease during 1992? (Paperwork, stockmen's grazing meetings, vandalism, rounding up stray stock after gates are left open, meetings with federal personnel, etc.)

137

	Transportation		Labor			
	Vehicle Type	Mileage	Manager Operated (hrs)	Family (hrs)	Regular Hired (hrs)	Day (hrs)
Paper work						
Meetings						
Vandalism						
Stray roundup						

VII. DEATH LOSSES

A. What was the average 1992 livestock sale weights?

_____ Steer calves
 _____ Heifer calves
 _____ Yearling steers
 _____ Yearling heifers
 _____ Cull cows
 _____ Lambs
 _____ Cull Ewes
 _____ Cull bucks
 _____ Wool per ewe

B. How many livestock died or disappeared on this lease in 1992?

Cows _____

Yearling Steers _____

Yearling Heifers _____

Steer Calves _____ Heifer Calves _____

Bulls _____

Rams _____ Ewes _____

Lambs _____

VIII. LABOR

This section of the questionnaire asks about the labor requirements (number of people and the hours required) to move livestock to the lease, to herd and distribute livestock on the lease, to gather and move livestock from the lease, to maintain the physical requirements of the lease (fences, water tanks, dams, etc.) and the labor requirements for animal health and maintain (herd checking, doctoring, salting, feeding, watering, etc.).

138

	Pay Unit* (code)	Wage rate per unit time	Approx. monthly cost for social security, unempl. insurance, room and board and benefits.
Hired Manager			
Hired labor			
Day labor			

*Paid by: hour=1 day=2 week=3 month=4 unpaid=5 exchange=6

	Livestock to lease (A)		Herding, distribution, grazing mgt. (B)		Maintain' lease (C)		Animal health and periodic inspection (D)		Gathering & moving livestock (E)	
	no.	hrs.	no.	hrs.	no.	hrs.	no.	hrs.	no.	hrs.
Yourself/manager										
Family members										
Regular hired labor										
Day Labor										
Exchange Labor										

IX. TRANSPORTATION

This section of the questionnaire asks about the vehicle requirements to move livestock to lease, vehicle requirements to herd and distribute livestock on lease, gather and move livestock from lease, maintain the physical requirement of the lease (fences, water tanks, dams, etc.) and the vehicles requirements for animal health and maintenance (herd checking, doctoring, salting, feeding, watering, etc.).

(Please: use hours on farm and industrial equipment instead of miles)

This section of the questionnaire will ask about the transportation of livestock to and from the lease.

A. What is the distance from your ranch headquarters to this lease?

_____ miles

B. If livestock were not taken directly from the ranch headquarters, give the distance from the last lease, lease or owned pasture used.

_____ miles

C. How were the livestock moved to this lease?

_____ Hired trucks \$ _____ Total Cost

Owned trucks

Trailed

Other (specify _____)

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D. What was the distance to remove livestock from this lease or owned pasture?

miles

E. How were the livestock moved off of this lease?

 Hired trucks \$ Total Cost

Owned trucks

Trailed

Other (specify _____)

1. If hired trucks were used what was the total cost in transporting livestock from this lease, lease or owned pasture? \$ _____

[illegible]

*Some vehicles that might be used: Pickup, Pickup-stock trailer, Stock truck, Semi-tractor trailer, All-terrain vehicle (ATV), Water-tank truck, Tractors, Implements.

Of the total costs for equipment (to maintain this lease) what percentage was done by:

% Rented/Contracted

_____ % Owned equipment

X. Horse Use

This section of the questionnaire will ask you about the horse requirements to operate and maintain this lease.

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A. Horse requirements to operate and maintain this lease

Horse Requirements		
	Average number of horses used	Average days horses used
Livestock to lease		
Livestock distribution/herding/ grazing management		
Livestock gathering		
Livestock off lease		
Maintenance of lease		
Animal health and maintenance		

B. : What percent* of the total horse requirements were provided by the following:

_____ % Owned horses

_____ % Rented horses

_____ % Horses provided by hired range riders

_____ % Horses provided by friend or neighbor

_____ % Other:(specify:_____)

* Sum should equal 100%

END (Thank You)

